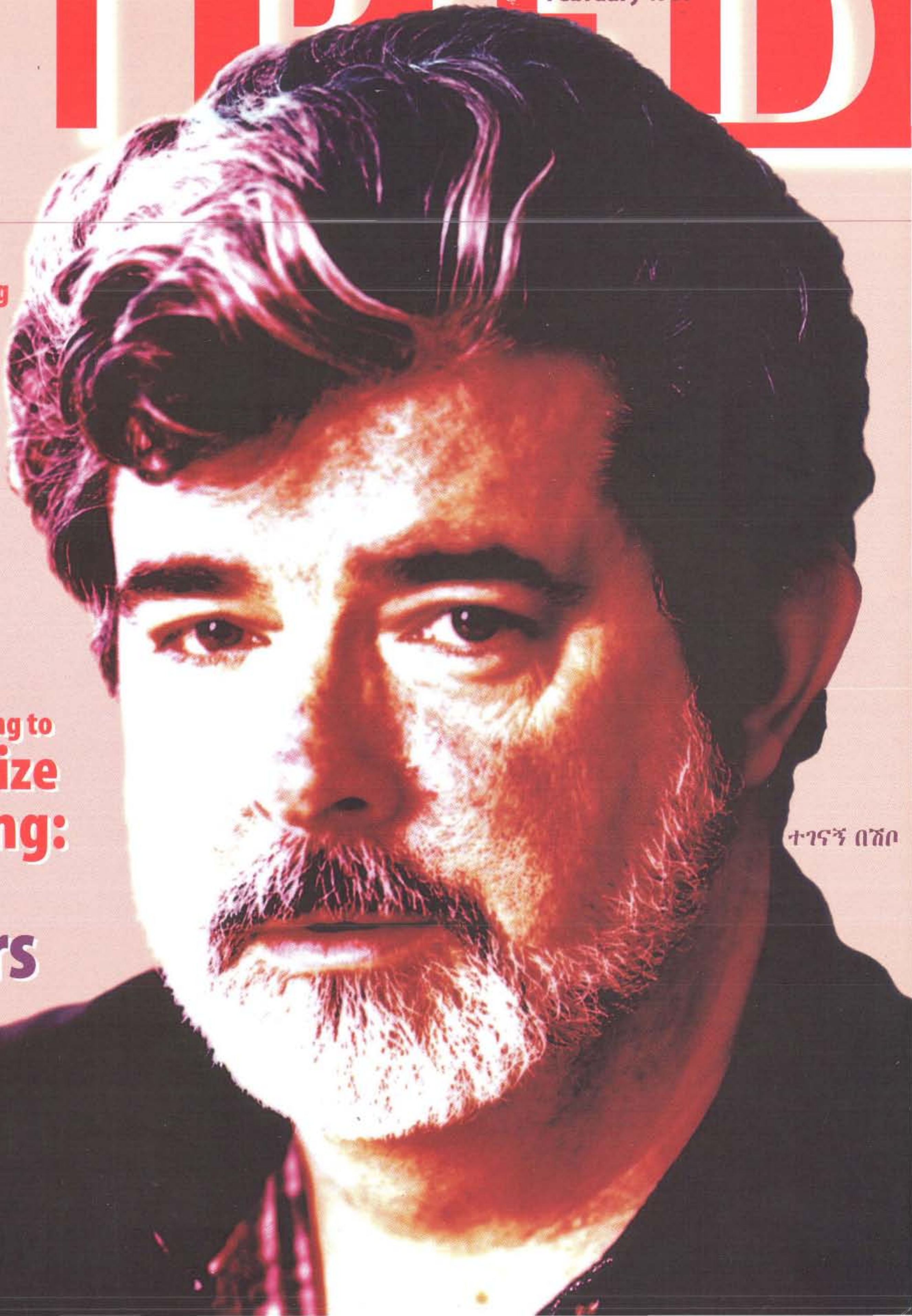
WIRED

February 1997



The Great HDTV Swindle

We Are (Already) Borg

David Gelernter's Radical Lifestreams Interface

The Wired Interview

George Lucas

tells us how he's going to **Revolutionize Filmmaking:** the next **Star Wars** trilogy

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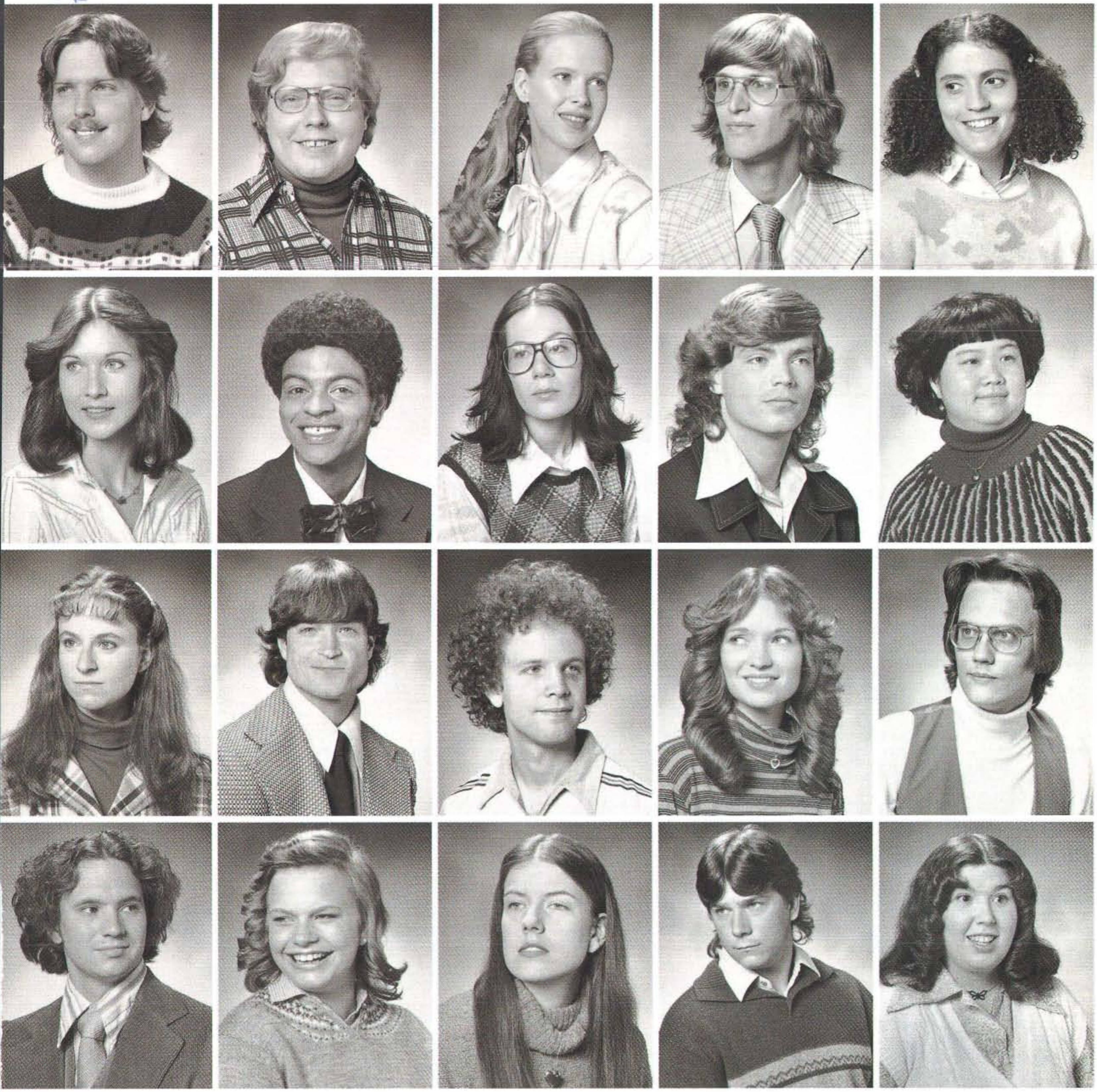

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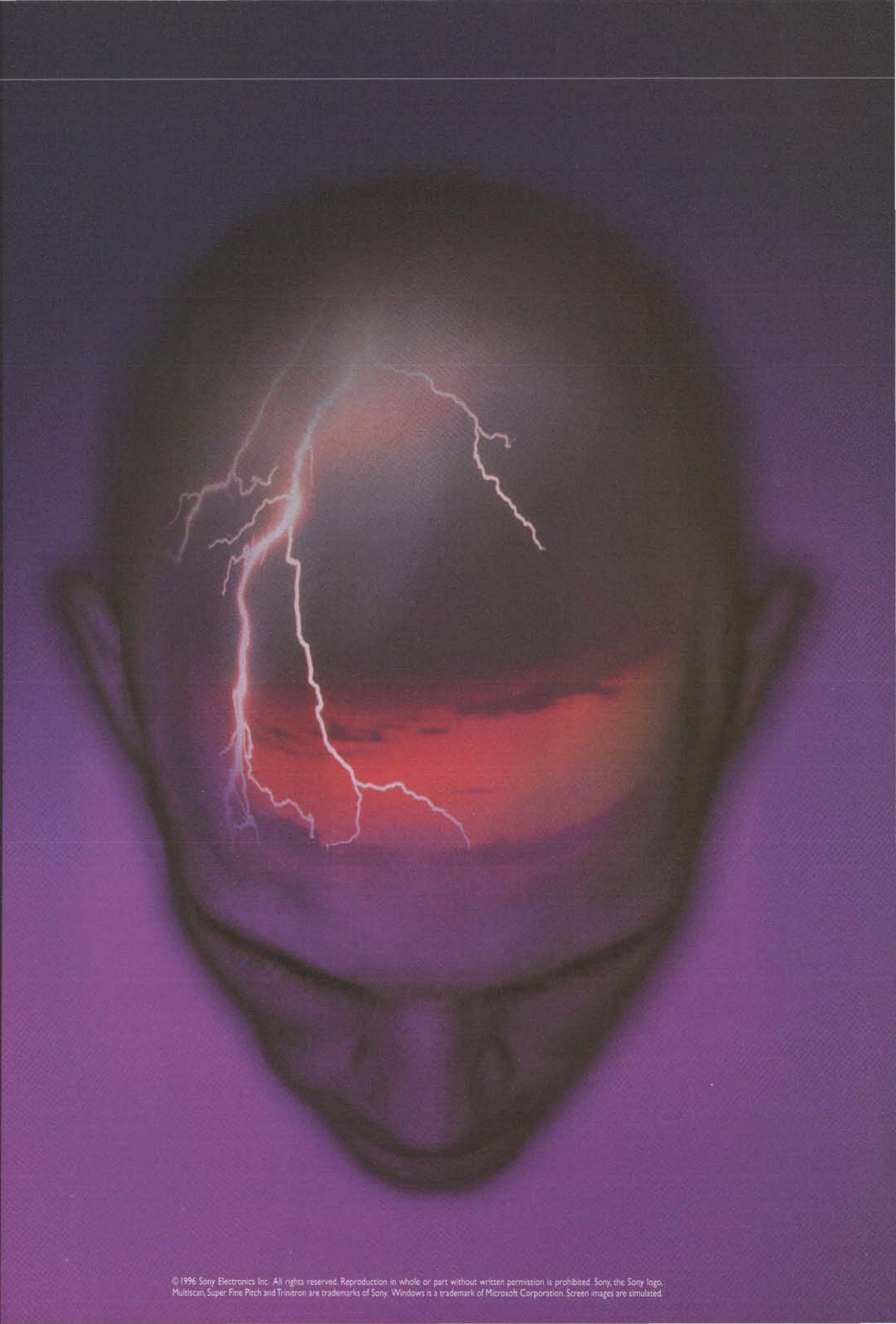

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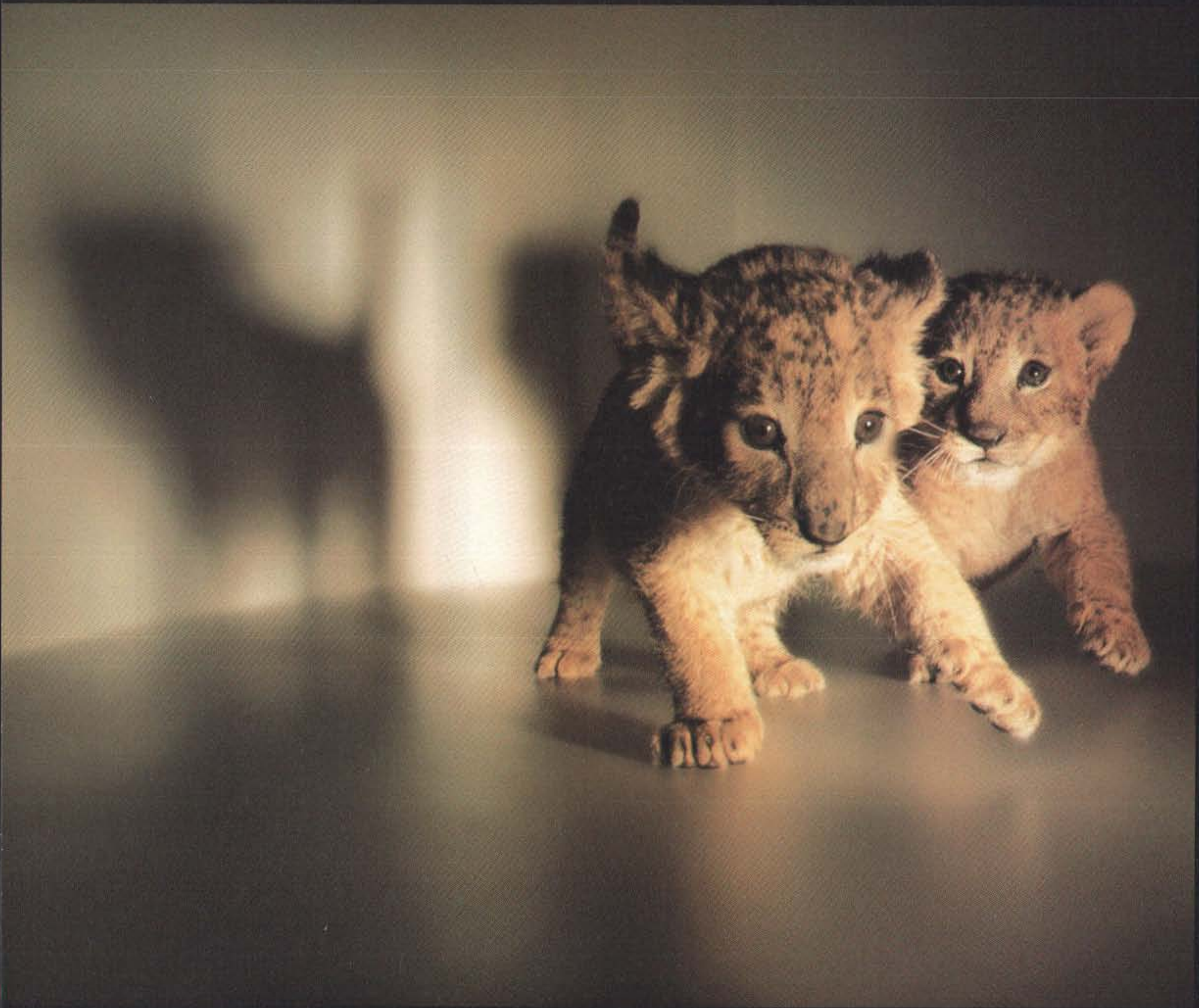

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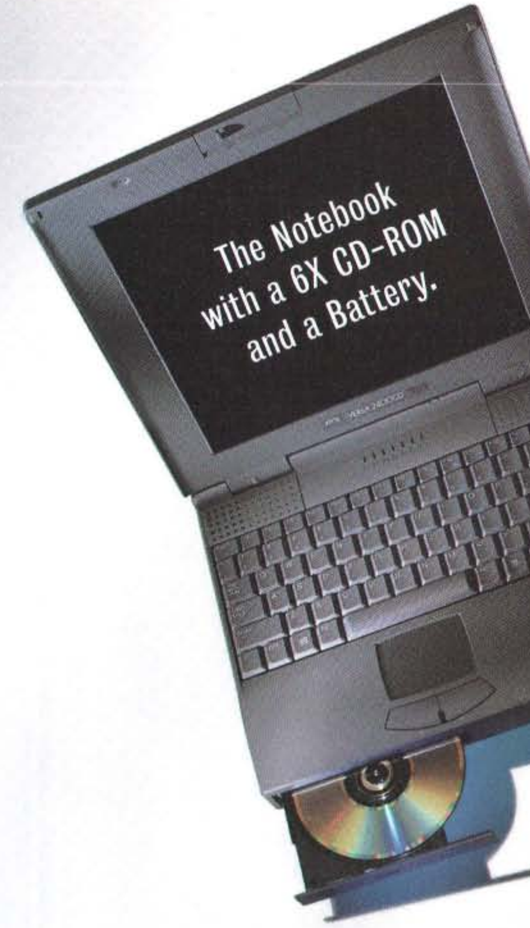

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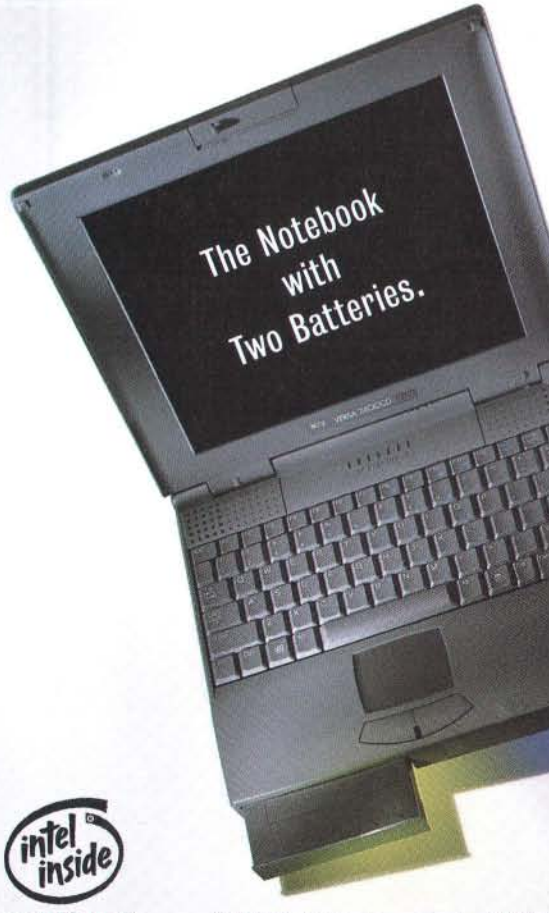

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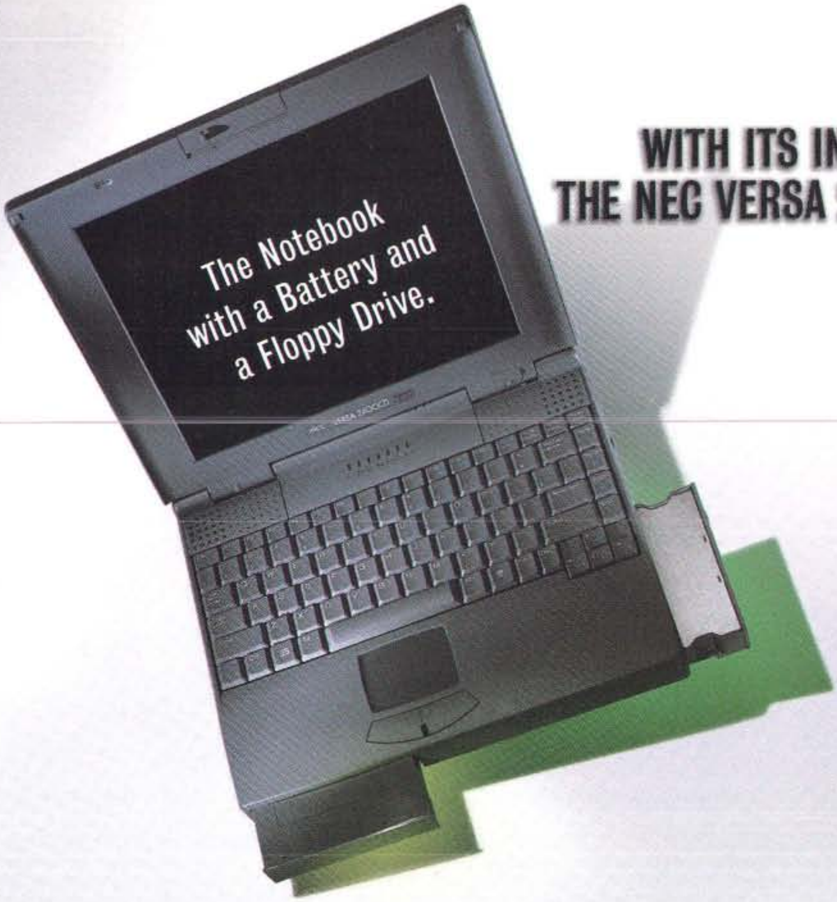

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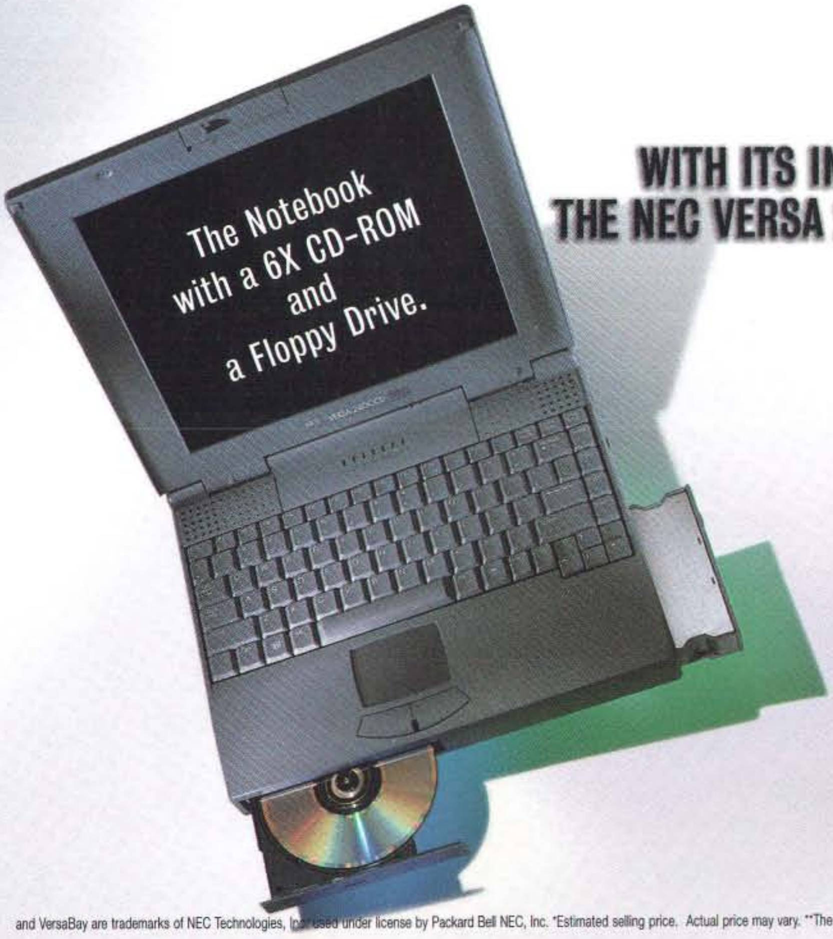

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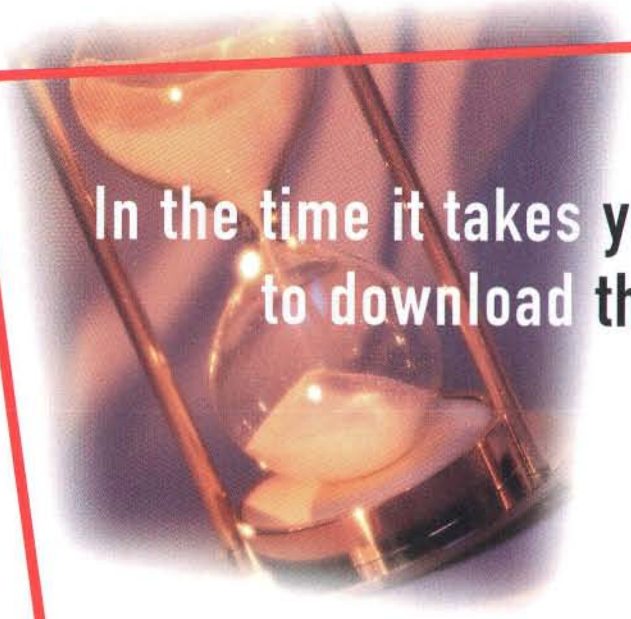

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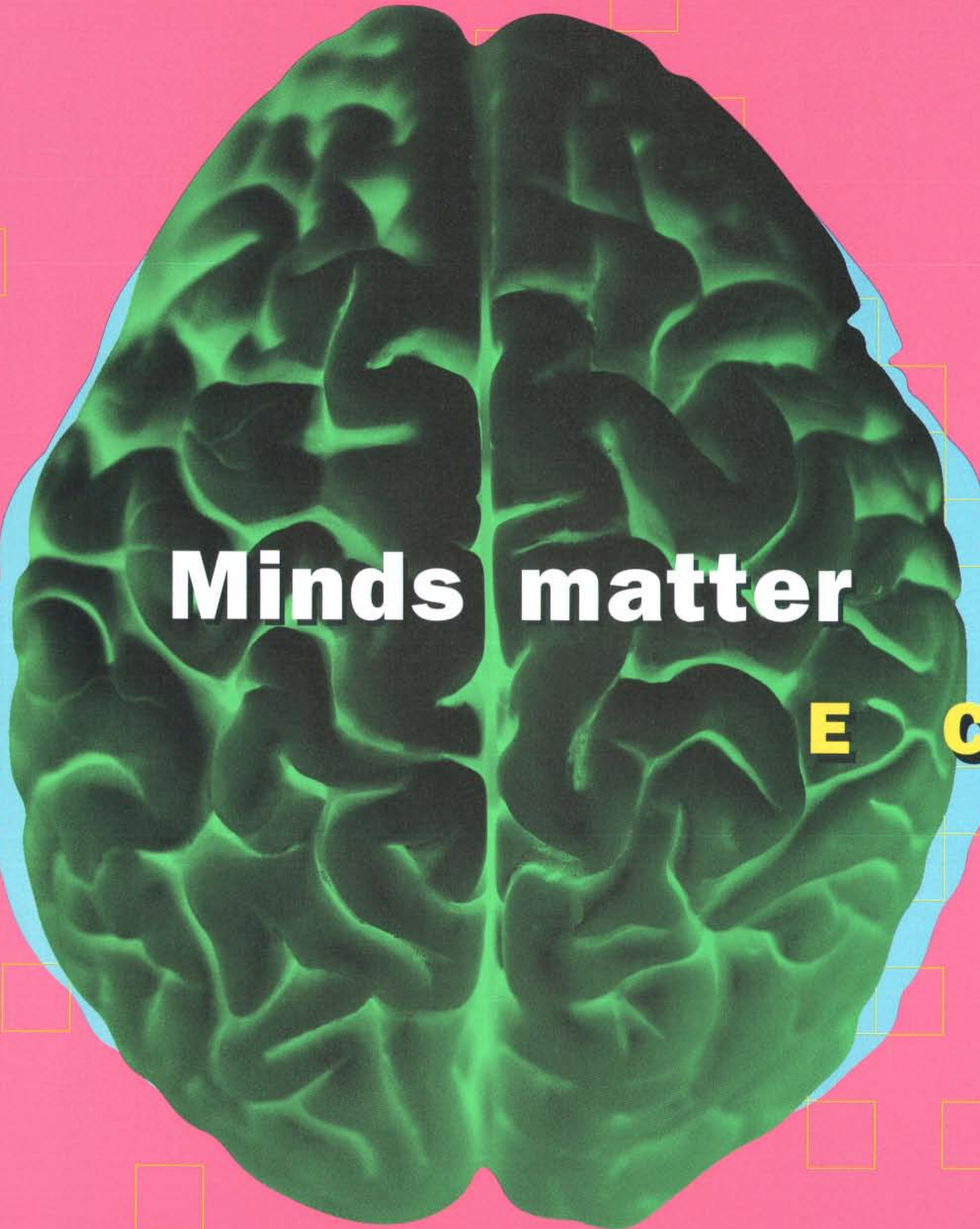

Minds matter

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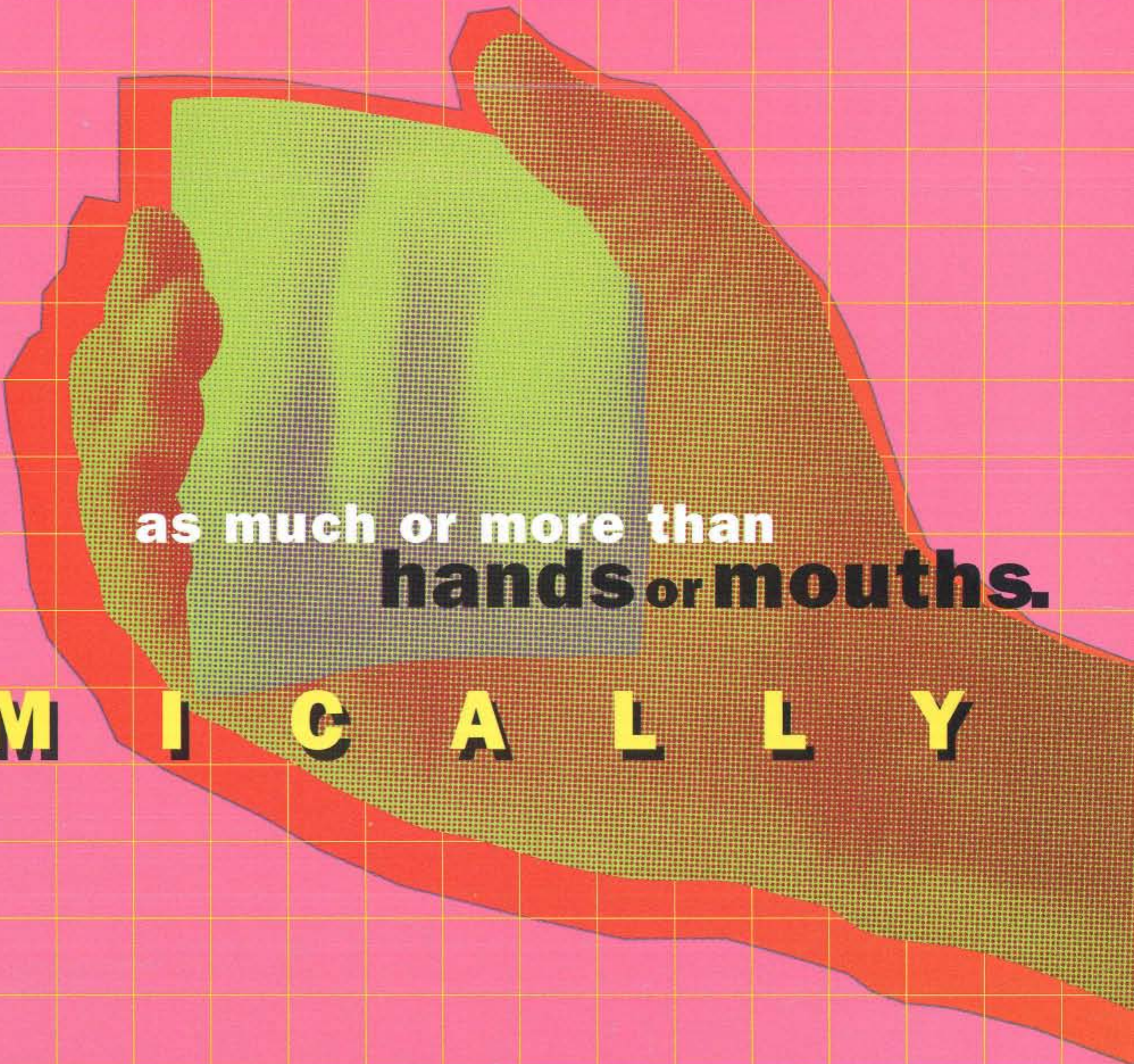
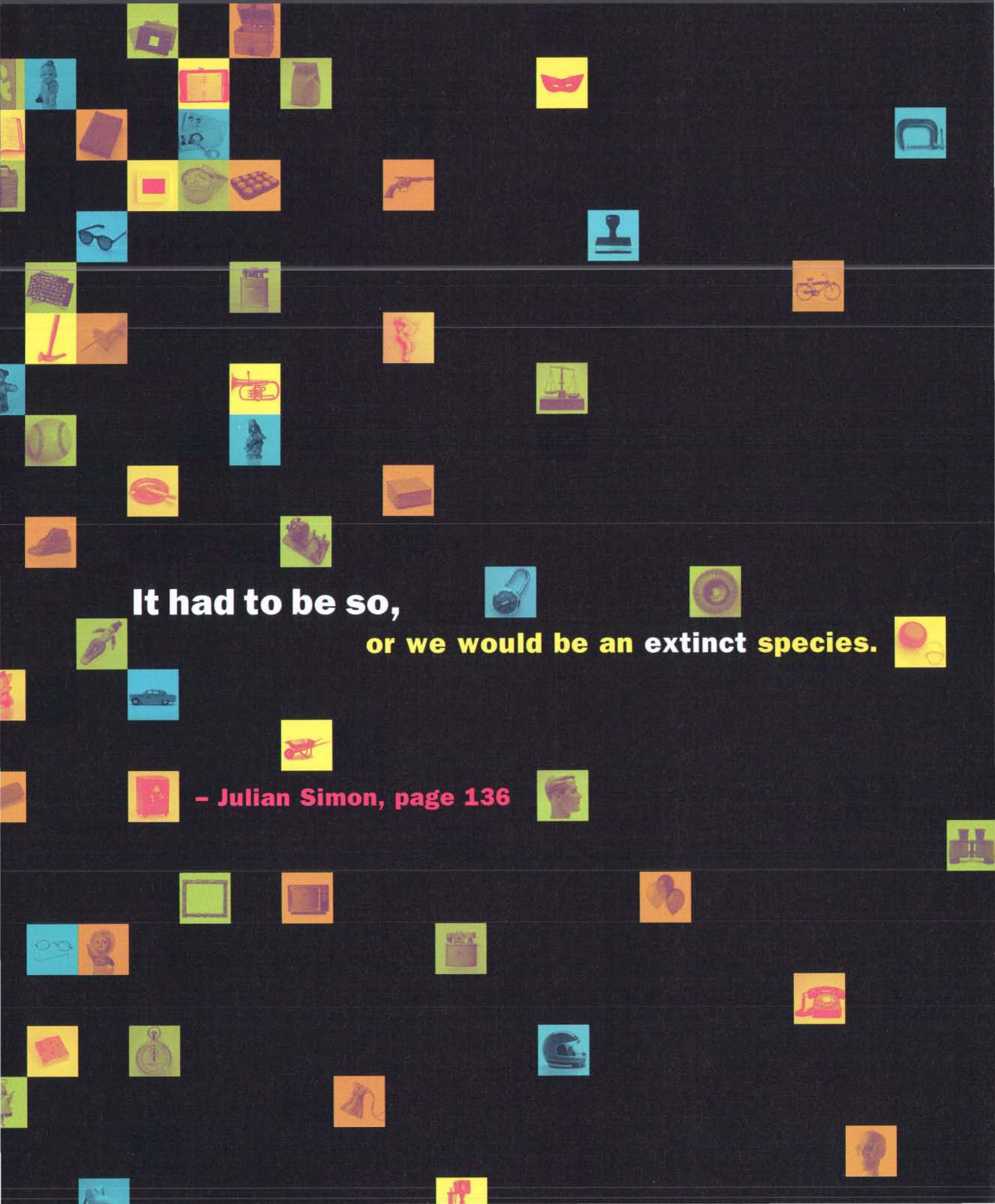


as much or more than
hands or mouths.

NOMICALLY

Human beings

create more than they use, on average.



It had to be so,
or we would be an extinct species.

– Julian Simon, page 136

57

The Netizen: The Great HDTV Swindle

Broadcasters are trying to make money the way they always have – by getting the government to give them free bandwidth and rigging the regulations in their favor.
By Charles Platt

136

The Doomslayer

The environment is going to hell, and human life is doomed to only get worse, right? Wrong. Conventional wisdom, please meet Julian Simon.
By Ed Regis

140

HyperReal

A new wave of computer renderings – such as Rafael Viñoly Architects' trompe l'oeil styling of the Tokyo International Forum – give unbuilt architecture an imaginative leap.
By James Daly

142

Internet Explorer

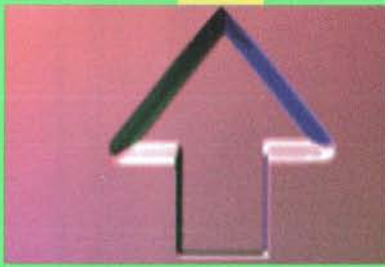
Steve Capps is the software genius who helped create the Mac, and he was chief designer of the Newton. Now, can he build a better browser for Microsoft?
By Rogier van Bakel

144

Hard Drive

The parallel universe of auto racing simulation is about to collide with reality.
By Rob Riddell

148



Lifestreams

According to David Gelernter, the desktop metaphor is obsolete. He wants to move beyond space – to time.
By Steve G. Steinberg

Context

Cover:
George Lucas photographed by Thomas Heinser, November 1996, Skywalker Ranch, California.

Introduction:
PhotoDisc CMCD Library
The Object Series.

Amharic translation
courtesy of Direct Language Communications Inc.

5.02

152

Win-Win World

Futurist Hazel Henderson has a modest proposal: Abolish economics and make way for the economy of abundance.
By Kevin Kelly

154

You Are Borg

For Donna Haraway, we are already assimilated.
By Hari Kunzru

160

Beyond Star Wars

What's next for George Lucas.
The Wired Interview,
by Kevin Kelly and Paula Parisi

36 **Rants & Raves** Reader feedback

45 **Electric Word** Bulletins from the front line of the Digital Revolution

65 **Fetish** Technolust

73 **Scans** People, companies, and ideas that matter

84 **Reality Check** The future of bionics

86 **Raw Data** Stats 'R' Us

88 **Geek Page** Mother Nature on a motherboard

90 **Follow the Money** Windows winners

92 **Deductible Junkets** Networking networks

94 **Updata** Bon voyage to Bob Stein, Craig Breedlove, Universal Avatars....

96 **Cyber Rights Now** Privacy: the untold stories

WIRED

February 1997

ELECTROSPHERE

98 **Head Start** By Samuel Greengard

108 **Hart of the Gutenberg Galaxy** By Denise Hamilton

IDÉES FORTES

123 **More Is Less** By David Shenk

124 **Give Workers a Free Choice** By José Piñera

171 **Street Cred**

175 **Just Outta Beta**

183 **Net Surf**

218 **Nicholas Negroponte**

Get Wired – online.
Look for URLs that begin

`www.wired.com/5.02/`

throughout this issue to connect with the readers and creators of *Wired*.

"When I logged on that Tuesday night

"It was supposed to be just another evening chat session on our genealogy forum, discussing family histories. We had about 15 people online from all over, including one gentleman logged on from Arbroath, Scotland. It was 4 o'clock in the morning there. Turns out he was alone in his apartment and not feeling very well.

"I didn't even notice when he first typed in 'I think I have a problem.' But by the time he wrote 'I think I have had a stroke' and I saw this stuff scrolling up my screen, I realized he was really in trouble. I kept writing 'what is your phone number?' He was barely able to see clear enough to key in his number - and then he stopped typing. I dialed the operator and within 2 minutes I'm talking to a police dispatcher in Arbroath. Ten minutes later, police made it to his home and found him lying on the floor, conscious but unable to talk.

"The next morning I was told that I'd saved this man's life. Fortunately, it wasn't a stroke, and he was home from the hospital later that day.

"At times like this, you don't stop to think - you just do it. Like, I didn't worry about my modem. I just knew it would keep me connected. I've been using personal computers for, oh, about 17 years now so I know what works. I put my

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HOW TO ENTER: Link to the Rockwell website at http://www.nb.rockwell.com and follow the instructions. In addition to entering the requested information, you will be asked to write a story, 75 to 100 words in length, about your use of a modem. Or, obtain an entry form by mailing a self-addressed, stamped envelope to: "WebStories Contest" -- Entry Request, 4311 Oak Lawn Ave., Ste 600/LB 18, Dallas TX, 75219-2315; requests must be received by January 15, 1997. Complete the entry form and mail with your story, regarding your use of a modem, to the above address, to be postmarked by January 31, 1997 and received by February 10, 1997. Be sure to mark the outside envelope "Contest Entry." Limit of one entry per e-mail address or by mail. Original entry form must be used. If an e-mail entry is selected as a winner, the prize will be awarded to the registered e-mail addressee. Stories submitted via regular mail must be legibly handprinted in ink or typewritten on an 8.5" x 11" piece of paper. Entries, via e-mail or regular mail, not satisfying the official rules will be automatically disqualified. All entries become the sole property of Rockwell and will not be returned.

WINNERS: Winners will be determined on or around February 28, 1997 from all eligible entries received. Stories will be judged based on which is the most compelling human-interest story that best reflects how your modem has allowed you to connect and make a difference; that is, how you have utilized a modem. All stories must be true. One winner will be selected in each of four regions/quadrants of the U.S. For make-up of regions, send a self-addressed stamped envelope to: 4311 Oak Lawn Ave., Ste 600/LB 18, Dallas TX, 75219-2315. Be sure to indicate "Regions" on the outside envelope. Entrant's state of residency will determine the appropriate region for purposes of this Contest. Entries will be evaluated by The Marketing Continuum, an independent judging organization. All judging decisions are final and binding in all respects. Entrants agree to these rules and to the judges' decisions. Winners will be notified by mail and will be required to execute an Affidavit of Eligibility, Liability and Publicity Release Form (where legal), Warranty of Originality and an Assignment of All Rights. If a winner fails to execute and return these materials within the prescribed time, prize may be deemed forfeited at the discretion of Rockwell and awarded to an alternate winner. Winners are responsible for all taxes. No transfer, substitution, or cash in lieu of prizes is permitted, except at option of sponsor for prize of equal or greater value. Acceptance of prize constitutes permission to the sponsor to use the winner's name, likeness, and story for purposes of advertising and trade without further compensation, unless prohibited by law. Rockwell is not responsible for illegible, incomplete, lost, late, misdirected or postage due entries/mail or for phone, electronic, network, computer, hardware, or software program malfunctions, failures, or difficulties. All ideas, concepts, copyrighted materials and trademarks contained in the entrant's story are assigned to Rockwell for any and all uses, and may thereafter be used by Rockwell without further compensation to entrant. All stories must be original work of the entrant regarding the indicated theme. In the event the Internet portion of the Contest is not capable of being conducted as planned due to computer virus, tampering, or other cause, Rockwell, in its sole discretion, reserves the right to cancel the Internet portion of the Contest and award prizes based on the mail-in entries only. By participating and winning a prize, winner releases Rockwell, its affiliates, subsidiaries, agencies, distributors and retailers, and their respective officers, directors, employees and agents from any and all liability with respect to participation in the Contest or acceptance or use/misuse of the prize.

PRIZES (4): A personal computer system including monitor and a Rockwell-based modem, with an approximate retail value of $2500, will be awarded to each of the four regional winners.

WINNER'S LIST: To receive a list of the winners, available after March 31, 1997, send a self-addressed envelope to: "WebStories" 4311 Oak Lawn Ave., Ste 600/LB 18, Dallas TX, 75219-2315. Be sure to indicate "Winners" on the outside envelope. Winners' names will also be posted on the Rockwell web site between March 31, 1997 and July 1, 1997.

I had no idea I would save a life."

system together myself. I pick components with the best performance and value. Like my modem. It has Rockwell chips at its heart. I wouldn't depend on anything less. I mean, you never know when a discussion about the family tree just might end up keeping one branch alive."

Richard Eastman
Compuserve® Genealogy Forum founder
Billerica, Massachusetts

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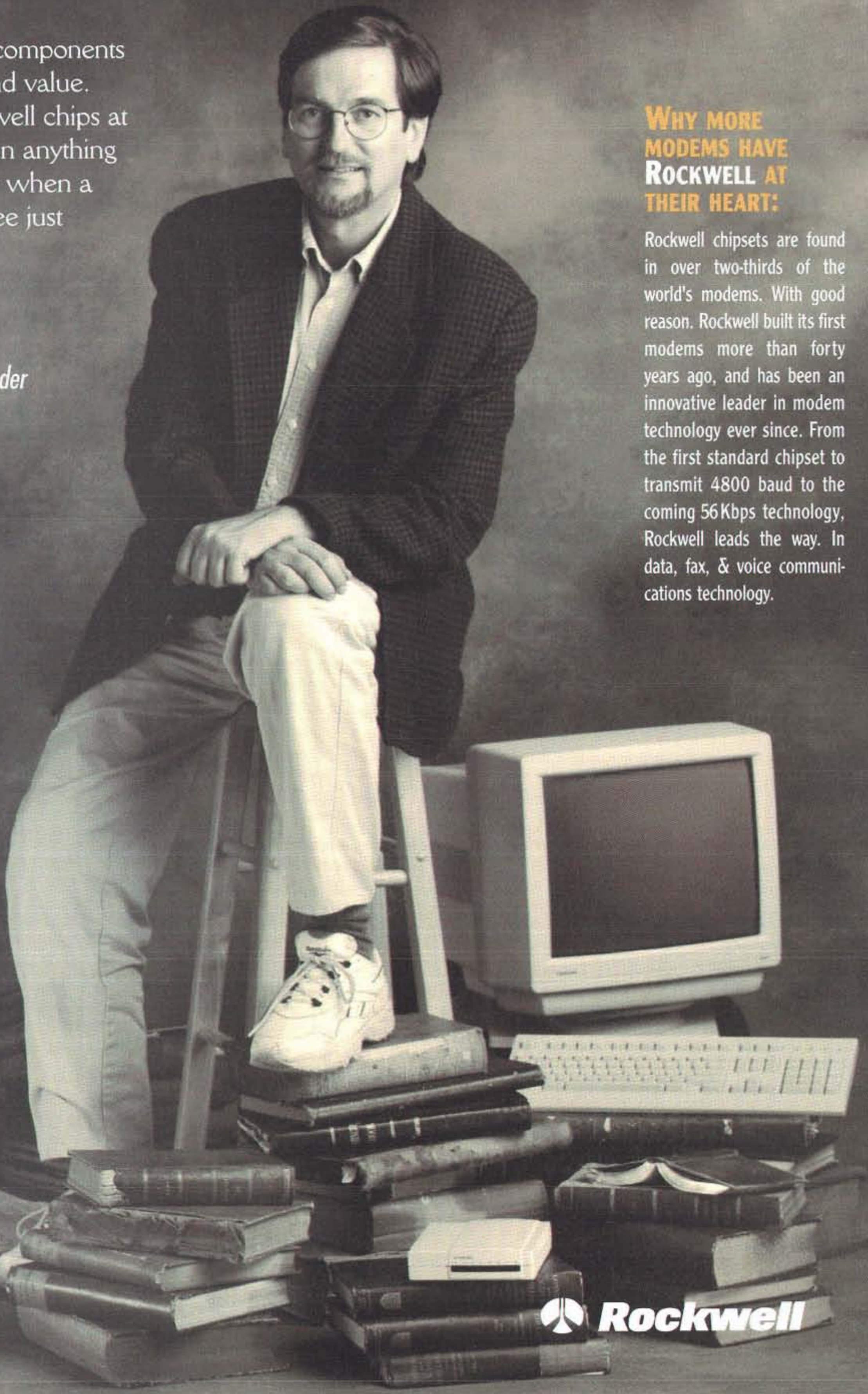

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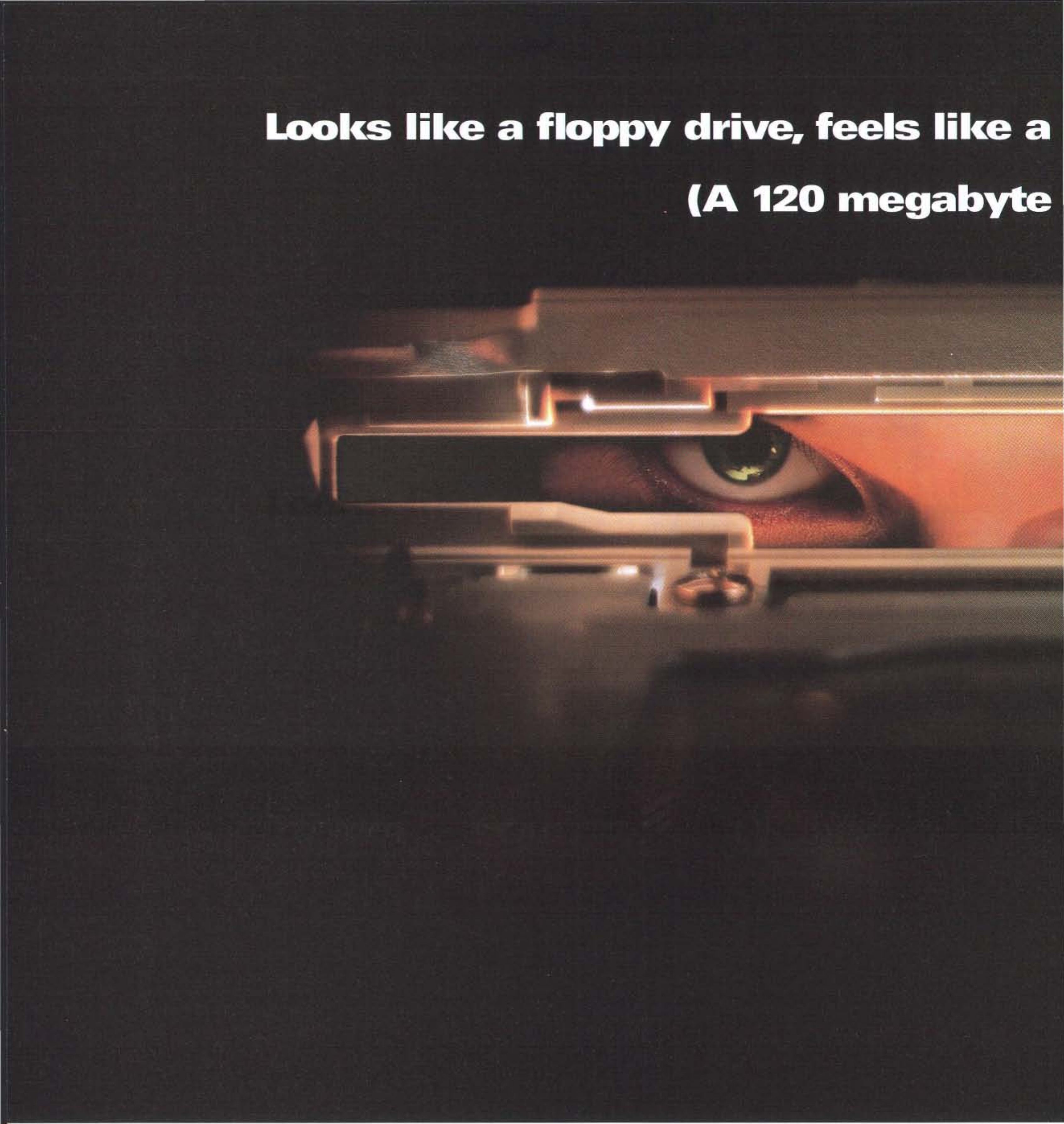

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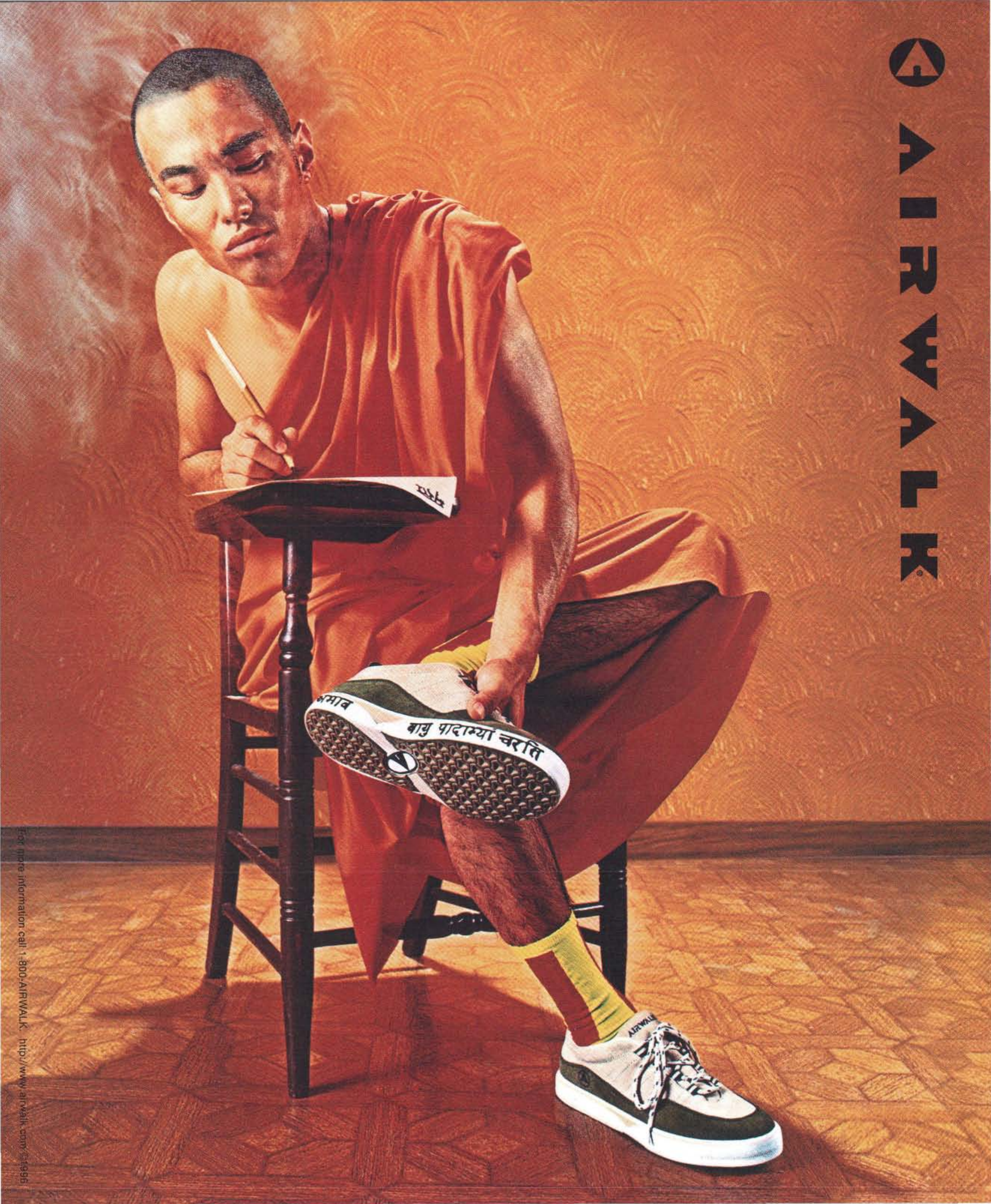
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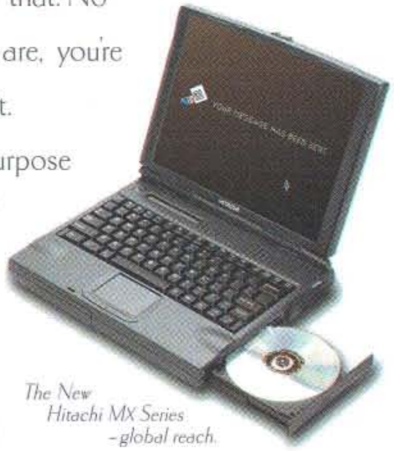

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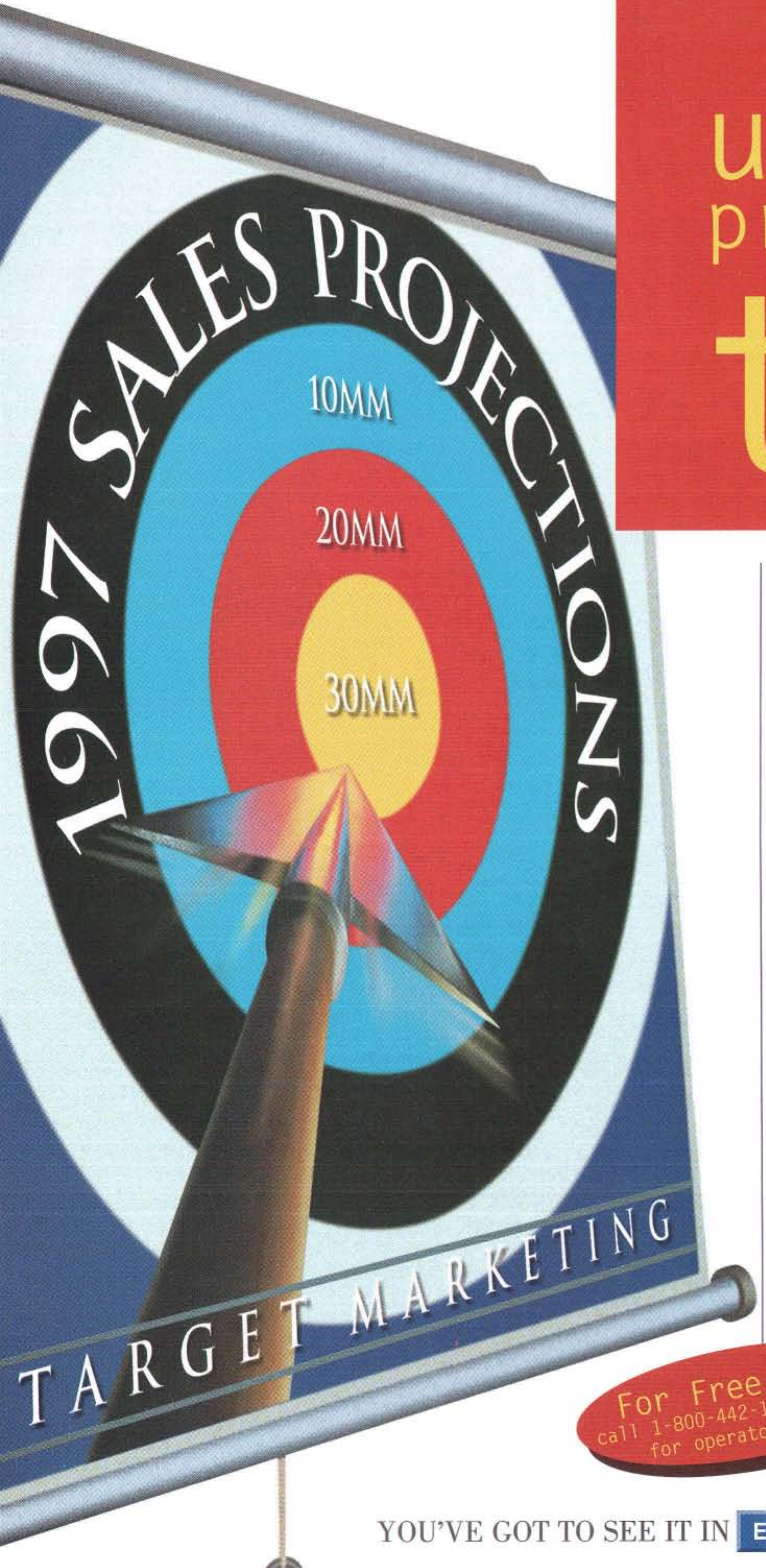

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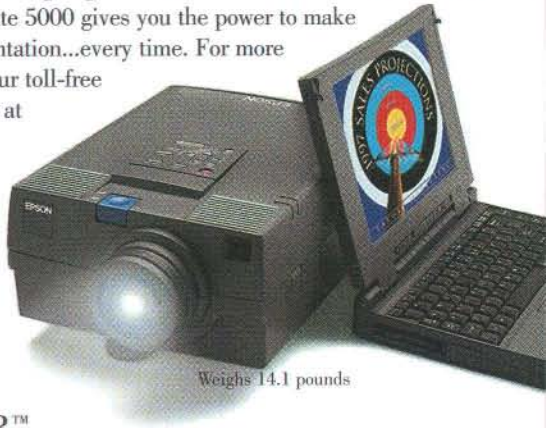
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The Burning Issue

While words on a piece of paper cannot do total justice to Burning Man, Bruce Sterling does a fair job ("Greetings from Burning Man!" *Wired* 4.11, page 196). I'd say a hell of a lot better than *SPIN*'s recent article.

I don't know whether to praise *Wired* for a decently objective article, or curse you for plastering the festival across the cover, thereby letting more clueless, unprepared yahoos (apologies to the Web site) know about this wonderful thing!

Pete Isaacson
penfold_of_terra@prodigy.com

The Burning Man cover caught my attention at once. I've been curious about the event ever since I read about it in *High Power Rocketry*. You see, high-power rocketry hobbyists consider Black Rock Desert an ideal place to launch their creations and hold their big annual shootout, known affectionately as Large and Dangerous Rocket Ships.

By the luck of the draw, one rocketry shootout coincided with Burning Man, and the rocket people returned home with breathless tales of a strange ceremony surrounding the burning of a giant human effigy. It sounded rather cool.

After reading Bruce Sterling's report and seeing the photos, I'm a bit disappointed. There's a lot of weirdness and chaos and debauchery, but there doesn't seem to be much point to it. The article overflows with Sterling's admiration of the "hippie tribal thing." But I despise hipness and trendiness and "art" that exists only to freak people. What ever happened to substance? What about the value of rational thought?

It disturbs me that Net culture has come to be associated with that kind of nonsense. I believe in constantly looking toward the future and working toward a better one. Where are we going? I don't claim to have all the answers, but I hope we are not going to a future where we strip naked, wallow in the mud, and prance about like idiots.

Tony Belding
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Better Latency Than Never

I was pleased by the discussion of network latency and interactive response times in "Best Size for a Planet" (*Wired* 4.10, page 133).

James Martin writes that "a signal can go a distance of 13,020 miles in 70 milliseconds. This is the greatest twitch zone possible. It is just enough. The farthest distance between any two points on Earth happens to be about 13,000 miles. The planet is the perfect size for everyone to communicate with twitch response times."

Would that it were true.

Unfortunately, Martin's calculations used the speed of light in a vacuum (300,000 kilometers per second), not the speed of light in glass fiber, which at 200,000 km/s is 33 percent slower. Martin also confused response time with one-way time. So, given that the circumference of Earth is 40,070 kilometers, the total round-trip delay to the far side of the planet and back over fiber-optic wires would be 200 milliseconds.

And there are other problems closer to home. If my next-door neighbor and I are dialed into ISPs using today's conventional 28.8 modems, the current round-trip message time is more than 500 milliseconds. Unless modem makers start caring about latency as well, we're not going to get 200-millisecond response times to the end of the street, never mind to the other side of the planet.

Stuart Cheshire
cheshire@cs.stanford.edu

Web Dreaming

I just read the article on *Suck* ("Web Dreams," *Wired* 4.11, page 166) and thought it was damn inspired.

I studied cultural anthropology in college but hit a crisis with it: How could I tell someone else's story? How could I understand a worldview separate from my own? Luckily, other anthropologists hit the same crisis, and a new school of thought – called interpretive anthropology, symbolic anthropology, or sometimes postmodern anthropology – was born. The idea is that the participant or observer status is no longer sacred – there is no way to penetrate another culture and describe it justly. The only thing that could be described is the relationship between the ethnographer and the culture studied. Which is exactly what Josh Quittner did in the article, and it was effective.

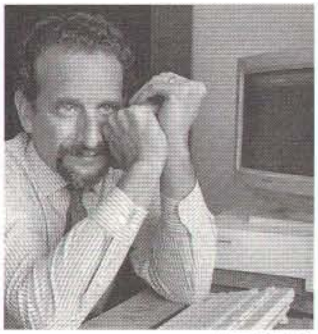
It's a funny thing. When we study relationship, we see both sides of the equation much more clearly. There is no objectivity. But if we dive boldly into subjectivity, we will grasp the heart of the matter.

Cathy Young
cafe@grouchy.com

IMAGE: LAURA MITCHELL

Larry Bowdish, Publishing Executive, 37; of Massive Hard Drive Failure

By SIMON BOWDEN



Larry Bowdish

He was the envy of the textbook ublishing crowd. The bad boy of e scholastic set. Witty, urbane nd outspoken, Larry Bowdish lit a sleepy industry with his meteric rise to the top, but the ride nded suddenly late one night last eek, when he suffered a devasting system collapse during final anuscript edits.

Mr. Bowdish's sudden demise ame as a shock to his friends ho recalled a man known for his oundless energy, determination, nd enthusiasm.

"Naturally, we're all a little unned," said Information Serces Director David B. Cohen, fter all, we encourage employees save their work every chance ey get." Said another colleague, ho asked not to be identified, t's so unfair. I mean, one minute ou've got the world by the tail and e next…you've been erased."

> *"One minute you've got the world by the tail and the next…you've been erased."*

"A team of experts have traced e system collapse," said Mr. Cohen, econstructing Bowdish's last ours and his desperate attempts at trieval." It now appears Mr. owdish was downloading from rporate archives onto his workstation, and periodically dumping onto floppy disks. "People can use floppies as backup, but obviously there's limited capacity. Besides, Bowdish was making changes straight onto the disks, not even keeping track of his changes. So, searching for lost data became a moot point," explained Cohen.

The controversial Mr. Bowdish combined a flair for the dramatic with a keen sense of publicity, not always welcome in the somewhat conservative milieu of textbook publishing.

Mr. Bowdish, who had no known history of hard drive failure, leaves no surviving software. In lieu of flowers, the family kindly requests all leads and reasonable job offers be forwarded to the home address.

Web Designer Gary Stepniak, 24, Burglary Victim

By SIMON BOWDEN

The computer graphics industry as saddened yesterday to hear of e loss of Gary R. Stepniak, President of Internet startup Steptooniaks.

Mr. Stepniak's laptop was stolen a weekend break-in. There are surviving files.

"Everything was on there," mented Blake Olson, Mr. epniak's partner. "Basically, e're screwed." Close business ssociates and the firm's few maining clients believe that, had r. Stepniak simply purchased an external back up drive, Mr. Olson would not now find himself in the painful and somewhat embarrassing position of explaining his ex-partner's tragic blunder.

Mr. Olson wishes to express his heartfelt appreciation for the tremendous outpouring of support and condolences offered from the design community.

"Make no mistake. We're still in business despite everything," insisted an obviously distraught Olson, "No doubt, this is a great loss for the company. Of course, we'll miss Gary, too."

Crashes

Churbuck, Megan

Esposito, Lori

Hornick, Amy

Lewis, Stephen

Noble, Joanne

Rauscher, Stacey A.

Svizzero, Ron

ESER, Richard J. of New York y. Desktop computer, aged 3 rs. Software included spreadeets, word processing, and a aphics program as well as a omising screenplay, his son's book ort and other documents for siness, personal and family use.

Crashes

BEATTIE, Maureen of Seattle, WA. Losses included a powerful new desktop PC with 8k RAM, built-in hypercard modem, undetermined and customized software. For complete listing, see today's classified advertisement section under 'Computers and Office Equipment For Sale.'

CHARTRAND, Cindy, 36, of Castaic Juneti, CA. Born July 15, 1960 in Manchester, New Hampshire. Mother of Andrew and George. Survived by brothers Errol and Peter, dozens of friends and relatives, plus several erased and useless disks.

Crashes

DOWNES, Laura. Late of Medford, MA. Beloved ex-small business owner, wife of Jock, mother of Shannon, Timothy, Jr. and Elizabeth. Survived by scores of customers, suppliers, tax attorneys, accounts due, and accounts payable. Your records will be missed by us all.

SILVERIO, Guy, aged 41, of Dallas, TX. Travel agent whose system failure meant the loss of confirmation codes and customized itineraries. Survived by scores of travellers stranded in unknown locations around the world, including his wife and daughter who relatives think are somewhere in Greece.

ALL STORIES AND CHARACTERS REPRESENTED ON THIS PAGE ARE FICTIONAL. ANY SIMILARITY TO REAL PEOPLE IS PURELY COINCIDENTAL.

Nancy Conaty, 34, Accidentally Trashed by Four-year-old Son

By SIMON BOWDEN

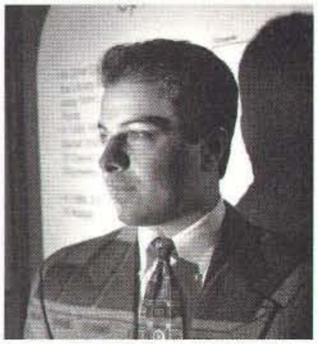
Mrs. Nancy Conaty was sole proprietor of an executive search firm run out of her home. The end came in a tragic family accident late Thursday afternoon. Mrs. Conaty had gone into the kitchen to check on a pot roast when son Joey dragged her unsaved document into the trash, then pounded unknown commands on the keyboard.

The computer was rushed to a neighborhood computer store where specialists struggled frantically for hours to retrieve the work. Their attempts were in vain. The damage was too widespread. "Had this occurred with a safe backup in place, no big deal," the store manager shrugged. "But there's very little we can do in a case like this."

Friends of the bereaved declined comment. Joey has been keeping a low profile, playmates said.

Mysterious DOS-Based Virus Claims Famous Accountant

By SIMON BOWDEN



Stephen Cunningham

Stephen Cunningham, known affectionately in accounting circles as the Bulldog of Due Diligence, was found not at his desk yesterday morning.

His untimely exit from his usual post coincided with the discovery of corrupted files on the largest acquisition in the history of his firm. It is not known whether the data disappearance alone caused Mr. Cunningham's departure. But sources revealed that the ex-Senior Vice President's lengthy battle with a mysterious DOS virus was well documented within the firm.

"The guys from Tech Support were down here all the time," claimed long-time assistant Jane C. Deery. "Steve was always getting these weird system bombs. But he had such an amazing memory he was usually able to re-create what was lost. I've never seen anything like it." It remains a mystery as to why the departed simply didn't back up his hard drive.

Ms. Deery added Mr. Cunningham declined the traditional going away party, wishing instead to "just get on with things."

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Bloodsuckers

I understand a magazine like *Wired* wanting to support the high tech community, but Karen Donovan's article on California's shareholder lawsuit initiative ("Bloodsucking Scumbag," *Wired* 4.11, page 134) was every bit as biased as a piece of "No on 211" campaign literature. The article continually repeated the assertion that all shareholder lawsuits are "meritless" actions designed to "extort" high tech companies into large settlements to avoid "lengthy litigation."

The truth is that companies often pad forecasts to manipulate stock price, and, in some cases, executives dump shares before the actual earnings drive the stock price down. This is fraud. Under current law, executives who perpetrate this fraud, adding millions to their personal fortunes, can be totally protected from any personal responsibility. The fact that many victims of this fraud are the pension funds of retired persons is not trial-attorney propaganda. There have been dramatic examples – remember Charles Keating of Lincoln Savings? (My spellchecker suggested "cheating" to replace "Keating" – I was tempted.)

As for the threat that legions of high tech board members will "resign the day after 211 passes" – please! The millions that these executives can make is the carrot that drives innovation, but threat of shareholder lawsuits is a necessary stick to prevent the exploitation of innocent shareholders.

Matt Ward
Scotts Valley, California

Addicted to Speed

As I devoured the story on Craig Breedlove ("The Fast American Hero," *Wired* 4.11, page 184), I was pleasantly struck by the tone of the scribe, David Diamond. For once, a purveyor of unbridled thrust and horsepower such as Breedlove wasn't treated as a quaint freak by some glib journalist. Diamond actually seemed to grok the raw desire that propels visionaries such as Breedlove. The desire to reach Mach 1 on land is bold and outrageous; the related technology is the embodiment of grace and elegance.

But Diamond also grasped that in such speed-demon endeavors things can go horribly wrong: At Mach 1, shock waves almost certainly send the vehicle careening out of control at around 740 mph. The very possibility of failure makes these efforts interesting and provocative. (See Updata, page 94.)

Breedlove's success or failure is kind of a nonissue. Ultimately, the issue is humanity's atavistic quest for speed, speed, and more speed, which has reached a fevered pitch in our collective ID. Breedlove is the sublime manifestation of this.

Cole Coonce
dragusa@earthlink.net

Wealth If *Who* Wants It

Having experienced both schools of thought described by W. Michael Cox ("Wealth If You Want It," *Wired* 4.11, page 192), I totally agree that every individual has the ability to create whatever reality he or she wants. For many years I was a drug-addicted criminal, living outside of society. Family, acquaintances, and educators would see my potential and just shake their head in dismay and disgust.

But in prison I took a business software class. The ill-equipped classroom held half as many 8088s as it did minds hungry for knowledge and a break from the daily grind of prison life. To make a long story short, 11 months later I own my own company focused on communications and computing. The quality of my life has improved 1 million percent. Each day I strive to learn more. My success is based on my own efforts (and a few well-placed coincidences). I receive no financial help.

Bruce Q. Burke
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Exactly whose bootstraps is W. Michael Cox supposed to have pulled himself up by? And who is Kevin Kelly deluding when he writes, "He speaks from personal experience. Cox, 46, began working in his father's bottling plant … at age 12"? His father's bottling plant? While that's not a Hyannisport upbringing, it's hardly the lap of adversity. Perhaps Cox's essay for the Federal Reserve Bank of Dallas should have been titled "By Our Own Wingtip Laces."

What really should have clued Kelly in to the man's value as an analyst was Cox's statement regarding work-related injuries: "Why is it that 100 years ago people worked harder but you didn't see a lot of disability? People carried 100 pounds of sugar around all day and they worked without injury for many years." Yeah, right. Histories of the time are filled with accounts of families driven to ruin by the injury of a guy whose only skill was moving heavy crap from one place to another.

Darrel Plant
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Your interview with W. Michael Cox illustrated a profound and dangerous conflict deep in the *Wired* CPU – the worship of raw capitalism, corporate power, and getting rich (which Cox claims is what "most of us aspire to"), while simultaneously celebrating the core anarcho-democratic ideals of the Internet and the Web. Hint: The government is exactly what makes capitalism and democracy able to coexist. Capital is not democratic. Capital and its organ-grinder's monkey, advertising, are coercive, manipulative, and solely self-interested. The government, about which Cox has little good to say, is at least elected democratically.

Cox supposedly reads history, but does he remember it? He completely dodges the question of the widening income gap between the rich and the poor by saying: Why attack the rich? Yet history has shown repeatedly that wide gaps between rich and poor lead to instability – exactly the conditions in which capitalism suffers the most. Capitalism needs stability. In the 1890s and 1930s when this country became dangerously unstable, it was the government that stepped in and restored stability.

Wired's cocky, smug good looks and bright colors won't wear so well when the cancerous tumors start to swell under the ozone-depleted, carbon-dioxide sky, as PCB-filled waterways flow past sardine-packed prisons. Capitalism and the market do not provide for all human needs.

Bob Klein
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The Netizen RIP

When John Heilemann describes himself as "incapable of speech, let alone complex thought" in "Old Politics RIP" (*Wired* 4.11, page 53), he and the headline writers and editors (if there are any) at *Wired* also prove themselves incapable of ordinal arithmetic.

The subhead declaims: "This isn't just the last election of the 20th century." This *isn't* the last election of the 20th century – unless the election in 2000 is canceled due to lack of interest.

The 21st century will begin at exactly 12:00:01 a.m. on January 1, 2001.

Robert Seulowitz
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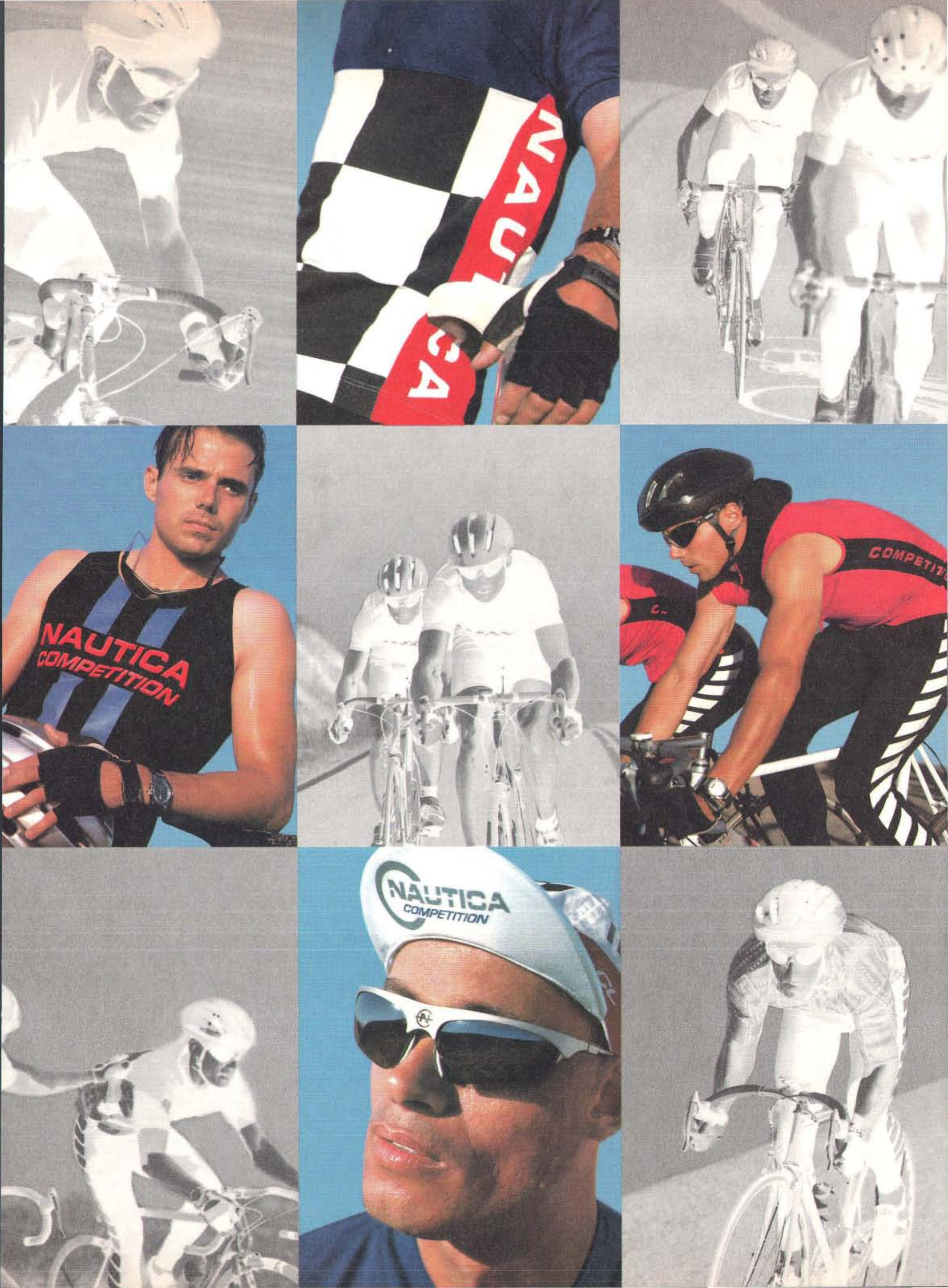
Can it really be a year since I got roped into reading this wretched monthly Netizen column? Here I am reading yet another installment of supposedly cutting-edge political journalism that is more concerned with advertising how cool the journalist is and pretending to be above it all than with truly presenting an unbiased, technologically advanced peek into the political campaigns.

The idea sounded plausible to me at first: be enlightened by the first digital boy on the bus. I was told this was going to be the first wired election. The candidates all seemed to have homepages. Every serious news outlet launched a political Web site. It seemed obvious that in the annals of journalism history, 1996 would be the year of "This is not political coverage as usual."

As if.

At least any illusions I had were shattered early. What I'm wondering, though, is if any sizable portion of *Wired*'s readership actually agrees with the pretentious pronouncements and prophecies of John Heilemann, or is gullible enough to believe that his deliberations exemplify progressive thought and unbiased reporting.

I should forgive Heilemann, though, because he seems to be surrounded by *Wired* editors who share the hallucinatory belief that the Internet/the Web/cyberspace represents some huge and meaningful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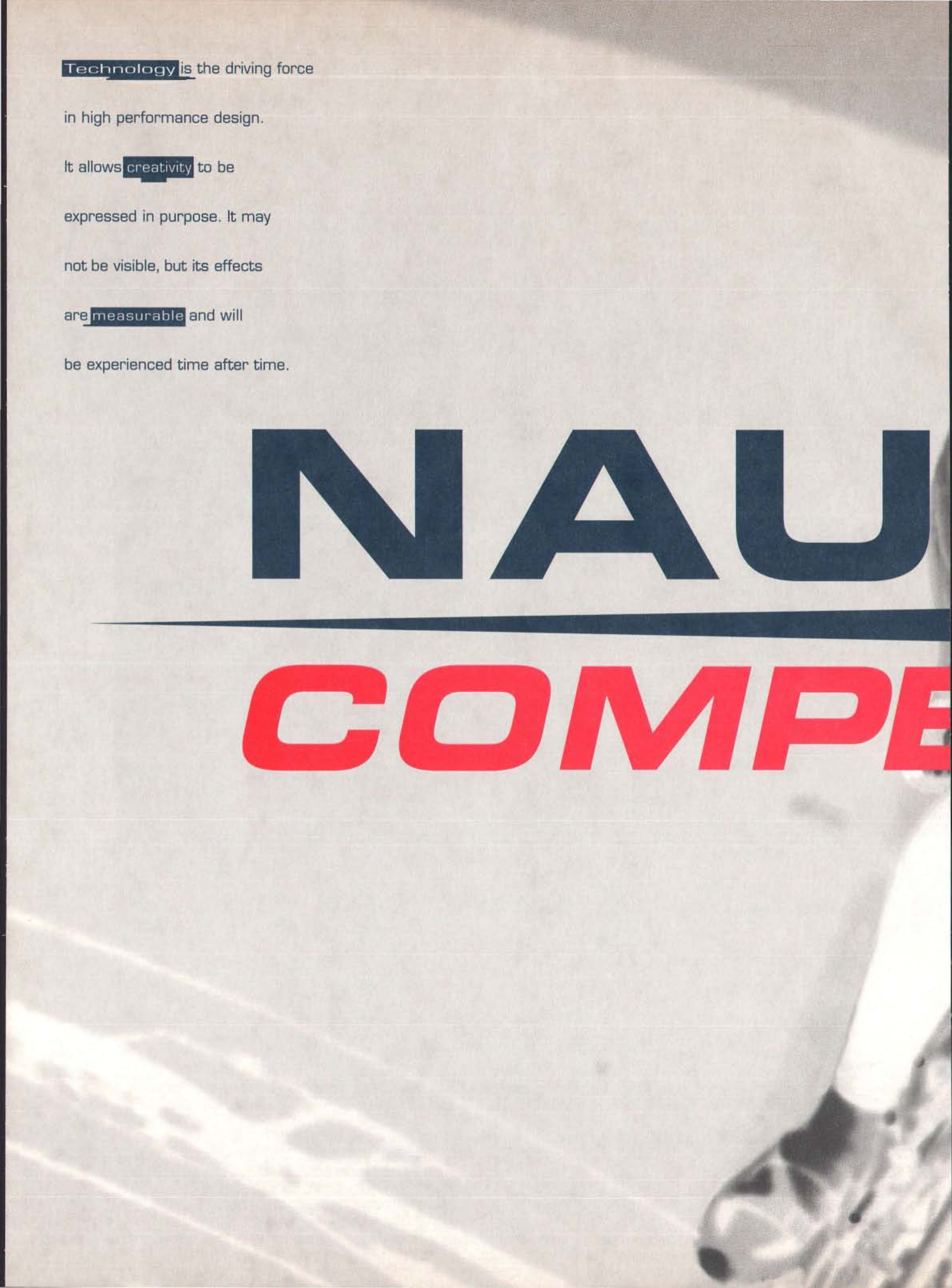

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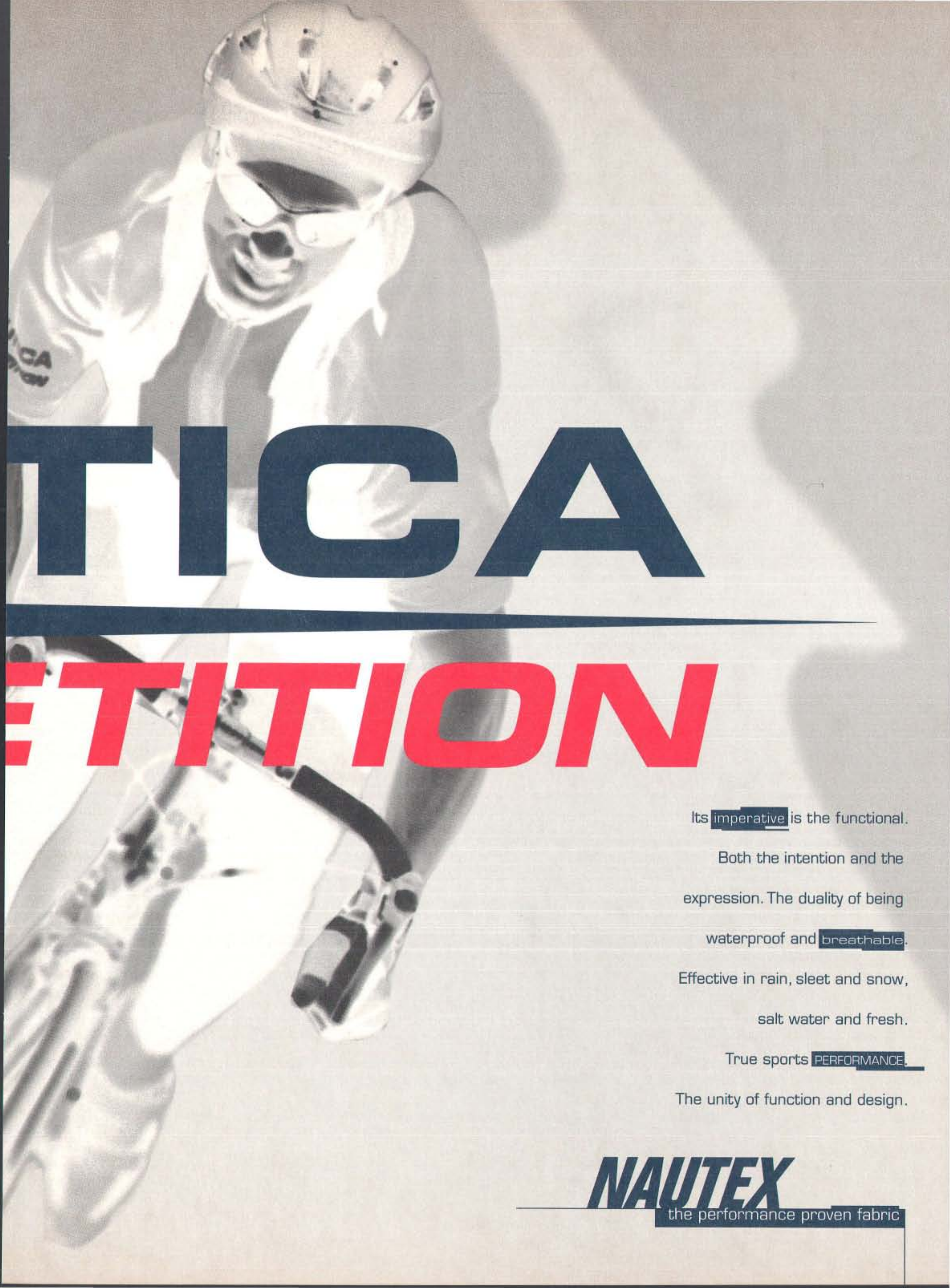
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"I was addicted to junk"

"**It started as a weekend thing.**

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some experimentation with Explorer.
At first it was
strictly 'recreational'.
Before long it became a habit.

A filthy habit.

Soon I was cooking my own,
hacking night after night
with **bad** tools, **bad** code, **bad** hygiene.
I told myself I could quit anytime.
I was wrong.
I thought I could control it
with **plugins, Java, ActiveX.**
They only made it worse.
My homepage was all messed up,
and everyone could see it but me.
I could feel myself
heading for a crash. A real
bad
crash.

That's when the monkey spoke."

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gateway to the inevitably techno-cool future.

The Internet is no more imbued with significance than residential climate control. In no time, it will be treated as just another modern convenience. And the digerati's belief that it is so hip and cool will be akin to an air-conditioning repairman's delusion that he's cornered the market on fresh air.

Keith Martin
mixedbag@mindspring.com

Cyberfantasies

I just read John Perry Barlow and Ann Beeson's contributions to "Cyber Rights in Fantasyland" (*Wired* 4.11, page 98). While I enjoyed the unintended self-parody, enough is enough.

Barlow wants us as a Net society to "live inside an environment of working anarchy." At least he understands that anarchy requires a great deal more of its citizens than an ordered society. For example, Russia has vast natural resources, a well-educated populace, technological sophistication, a huge market hungry for goods and services, and – since the collapse of its communist dictatorship – near anarchy. The result? Interior minister dismissed for plotting a coup, widespread social unrest, near economic collapse, and a dearth of significant investment from the West. The reason? The demands of anarchy are simply too much for humans to bear, even for Russians who are historically accustomed to bearing heavy loads.

Every healthy society must find a way for its members to cooperate. Mechanisms must exist for organizing and enforcing the relationships between individuals. In a democracy, this mechanism consists, on the smallest scale, of relationships formed through social institutions, primarily the family and the workplace. On a larger scale, these institutions take the form of corporations, school boards, civic organizations, and local and national governments. Our net consists of the thousands of social bonds which join us together as neighborhoods, workplaces, nations, and ultimately a global community.

Barlow would cast that all aside and replace it with anarchy, regulated only by the automated servers, routers, repeaters, hubs, ports, and strands of glass fiber that make up this new "net." It seems he has lost himself in a cold world, where data may travel at the speed of light but relationships – like an ISDN line – end when the power goes down.

Ann Beeson's delusions are less grand, but just as foolish. She would have the federal government preempt any state law regulating conduct on the Internet on the grounds that there are just too many states enacting too many dumb laws and it is just too damn hard for her to go around challenging all of the unconstitutional ones. At the same time, she would like the federal government to make sure that all the other countries in the world conform their laws regarding speech to our First Amendment.

Most important, the states are critical to stimulating the commercial development of the Net. Outside the securities and bankruptcy arenas, almost all commercial relationships in this country are governed by state law. The states have long dealt with problems of multiplicity by codifying standards into uniform laws such as the Uniform Commercial Code. Stripping this long-established and constantly evolving set of interlocking mechanisms for fostering commerce from the Net would be akin to ripping a newborn child from its mother's arms and installing it in a Skinner box with an automated nipple.

It will take a while to work out the various problems of Net regulation. There will be bumps along the road as institutions evolve and change. That is far preferable to clear-cutting the regulatory landscape and leaving the federal government as the sole tender of the new forest.

Craig Jordan
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In Its Image

While the story about Corbis ("In His Image," *Wired* 4.11, page 172) was accurate and informative overall, there was one incorrect statement about the prices Microsoft pays for images licensed through Corbis. Microsoft pays market rates, the same rates as any other Corbis customer.

Doug Rowan
President and CEO, Corbis
dougr@corbis.com

Richard Rapaport should know that da Vinci did not write his notebooks in a "secret code" – being left-handed, it was easier for him to write backward and pull his pen across the paper (as righties do) than to push the ink onto the page, smearing his writing and obscuring the thoughts and words.

An advantage to being left-handed is that I can read and write backward almost as fast as forward. This skill is very handy in business situations where presentations are made across conference tables and the ability to read your opponent's notes upside down and backward can give you a decided edge.

Dan Cohen
cohendr@aol.com

Who Can You Trust?

I have watched with amusement the threaded discussions (true rants and raves) of Clipper, key escrow, the threat of government access, and the demonizing of Dorothy Denning for abandoning her roots and entertaining the idea that Clipper is good. Most of those who rant and rave assume that we cannot trust our government, that it has some ulterior motive to monitor our communications, and that we netizens must find a better way.

Let's just assume (for the sake of discussion) that we cannot trust our government. What then? Whom do we trust? I saw an interesting page in *Wired* 4.11 (page 43 – an advertisement, I presumed) offering "Five Percent Wiretap-Free (Guaranteed!)." Indeed. Guaranteed?!? By whom? Who is "cypherpunk John Gilmore"? Why on earth would I trust him? How can I be assured that he has not engineered a trapdoor or Trojan horse and is sitting there monitoring all of our communications?

What if, on the other hand, we assume that there really is a threat from foreigners and criminals. Would we not want and demand that the government offer us a crypto system standard we could trust? Would we not also want them to ensure that criminals cannot use that standard to shield their illegal activities?

This issue transcends current political parties and personalities. At issue is the security of all Americans' personal and commercial communications. And I am willing to place more than my usual trust in the government because I don't see a viable alternative.

Bill Taylor
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Tropical Fever

One week into my 10-day vacation in the Florida Keys, I was beginning to get computer-withdrawal symptoms. By the day of my departure, the anguish was unbearable. The minute I got to the airport, I went into a magazine shop. I looked up and down the magazine racks for some kind of computer magazine. *PC World* … no; *PC Magazine* … no; *BYTE* … me; *Wired* … hmm.

I read the magazine from cover to cover, word by word, and, at last, the trembling finally stopped.

Depak Deo
depak19@starnetinc.com

Undo

▪ Notes from the Deadzone: In "Reclaim the Deadzone" (*Wired* 4.12, page 206), the sentence "There are three steps advertisers can take … " should read "There are three steps Web publishers can take…." ▪ Birdbrained: Our review of the *Monty Python and the Quest for the Holy Grail* CD-ROM ("Holy Python," *Wired* 4.11, page 226) mentioned an eagle – the bird was actually a sparrow. ▪ Misstated: The Medford Historical Society is located in Massachusetts, not Oregon ("In His Image," *Wired* 4.11, page 172). ▪ Twisted Roots: "The Cult at the End of the World" (*Wired* 4.07, page 134) described Nikola Tesla as Croatian-American. To clarify, Tesla was born in Croatia to Serbian parents.

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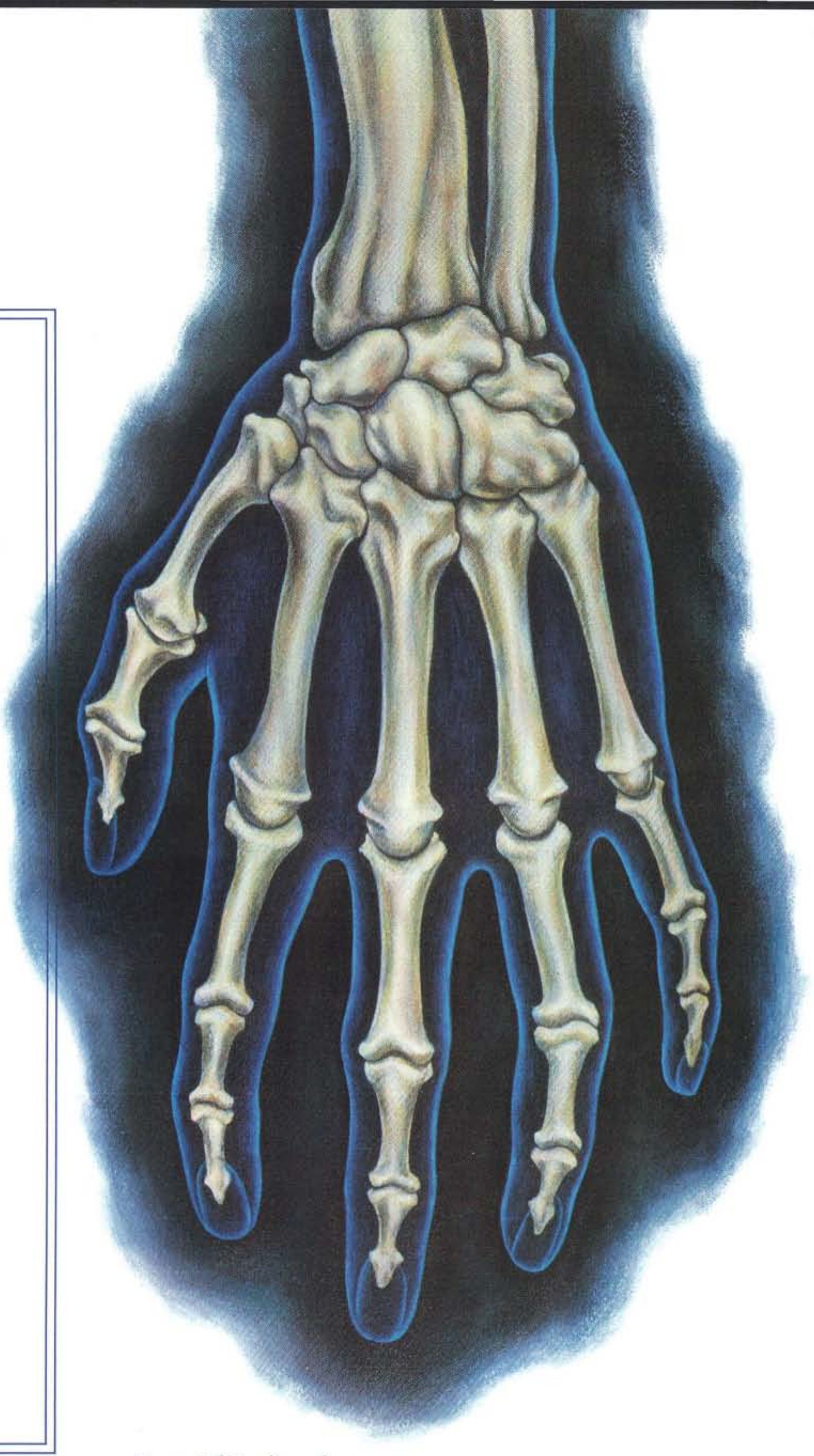

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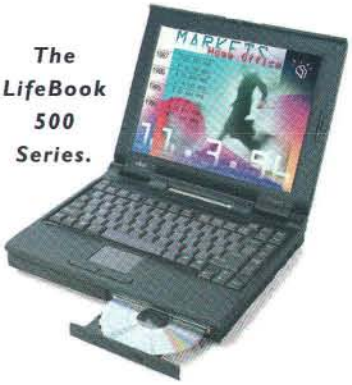
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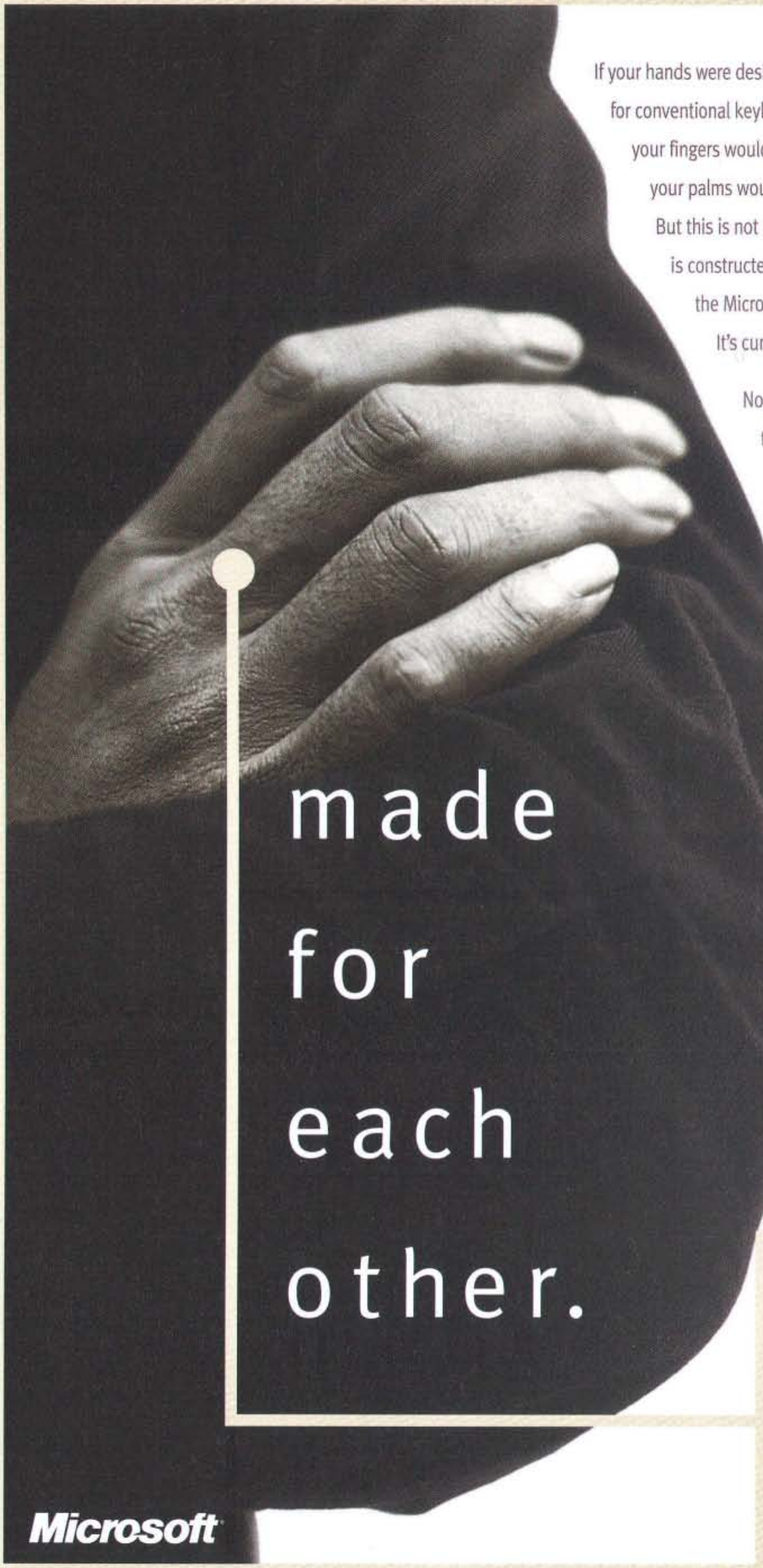

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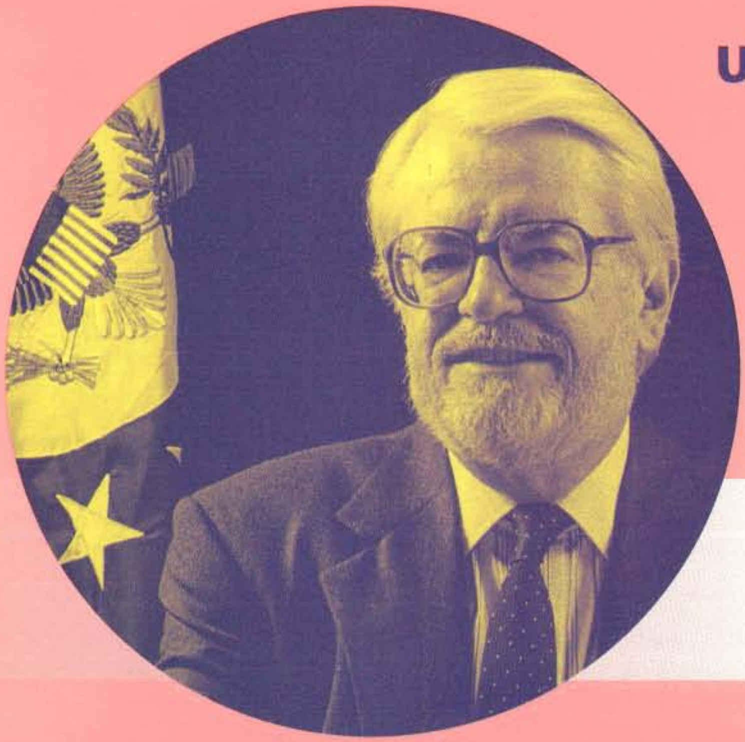

US Crypto Czar

When Bill Clinton wanted to sell the world on an unpopular US encryption policy, he knew where to turn to: a spy novelist.

David Aaron's latest book, *Crossing by Night*, delves into World War II-era cryptography by telling the story of how the Allies broke the codes of Nazi Germany's Enigma computer. Aaron, who also boasts a hefty diplomatic résumé, has been appointed field marshal in the modern war over encryption policy that pits law enforcement agencies against netizens. As the newly minted crypto-ambassador, his job is to lobby foreign governments to comply with US policy.

"This shows the White House is paying more attention to this issue," says David Banisar of the Electronic Privacy Information Center. "With Aaron having close ties to the intelligence community, it's bad news for the Net." – *Declan McCullagh*

ELECTRIC WORD

X Marks the Spot

Seattle programmer Fred McLain isn't making any friends in Redmond. To reveal the security flaws of Microsoft's ActiveX, he wrote Exploder. Posted to his Web site, the applet shut down the PC of any Internet Explorer user who visited the page.

McLain registered his applet with VeriSign, a company that issues digital signatures for ActiveX. And when the company got wind of Exploder, it canceled his digital ID. Exploder still runs but now informs that it has not been registered and gives them the option to cancel the download. Microsoft says this kind of accountability will keep ActiveX authors in line.

McLain says that he wanted to get caught: after all, he was trying to expose the dangers of the technology. A truly malicious coder could write an applet that pretends to be something innocuous – a tank war game, for example – while it scans your hard disk for confidential documents and emails what it finds to Argentina. – *Simson Garfinkel*

PHOTO ABOVE: OECD; PHOTO BELOW: ARCHIVE PHOTOS

Morphing into a Constellation

The launch of Netscape Constellation as a seamless Net-to-PC interface may signal an acceleration in the evolution of the desktop. But unlike Dave Bowman (see *2001*), we haven't yet reached a higher technical plane. Sure, we've crawled out of the muck of the DOS command line; reveled in our love of the Mac; then leapt into cyberspace using Navigator; and discovered our own obelisk on the moon – Windows 95 with built-in browser. Now Constellation (and PointCast, and IE) has put the desktop inside the browser.

But don't let Netscape, Microsoft, or PointCast fool you – we haven't reached Europa yet. Until we're accessing gigabytes of data at gigabit speeds, we're no surfing Star Children. – *Ned Brainard*

≡III Piracy Ho!: Remember the Software Publishers Association? (See "The Software Police," *Wired* 3.05, page 88.) Just in time for the WIPO wipeout – the imminent vote by international delegates for restrictive copyright measures in cyberspace – our friends at The World's Largest Software Companies have come up with "guidelines" they would like all ISPs and Usenet server sites to follow. These include "naming someone responsible to use their best efforts to ensure that the unauthorized reproduction and/or distribution of copyrighted computer programs does not occur on or through its servers." The SPA also suggests that sites monitor all links in case they lead to pirate nests. Neat! An officer for every node! After hearing no end of it from ISPs, the SPA relented, now arguing that ISPs should at least run Java scripts chastising would-be warez traders. Hey SPA, what's ►

Scouting the Supremes

In December, the Supreme Court announced it will hear the US government's appeal of last year's *ACLU v. Reno* ruling – a case that declared the Communications Decency Act unconstitutional. Experts believe the justices will uphold the ruling. "A few provisions might survive review, but most of the legislation will be held unconstitutional," says Harvard law professor Laurence Tribe. Here's our thumbnail sketch of the Court's jurisprudence. – *Todd Lappin*

Justice	Likely Vote	Background
Stephen Breyer	👍 ?	Will approach this case from a technocratic liberal perspective. Free speech record is mixed. Has often upheld regulatory statism and deferred to government agencies.
Ruth Bader Ginsburg	👍	Although liberal on most First Amendment issues, Ginsburg often sided with FCC regulators while serving as a lower court judge. Still, it is believed she understands that the Internet is not like television.
Anthony Kennedy	👍	A highly principled conservative and a consistent free speech advocate, Kennedy could be a pivotal vote. Often takes a libertarian approach to First Amendment issues.
Sandra Day O'Connor	👍	Mixed record on free speech cases. May follow Kennedy in this case. Opposed First Amendment protection for flag burning. Noted for a strong emphasis on factual detail.
William Rehnquist	👎 ?	The conservative Chief Justice has strong statist tendencies. May vote to uphold the CDA, particularly if Scalia and Thomas do the same. If he decides to strike it down, it will likely be on very narrow grounds.
Antonin Scalia	👎 ?	A quixotic conservative, Scalia is hard to predict. Opinion may hinge on specific language in the CDA. May vote to strike down the CDA, if he defines the case in terms of federalism and state rights.
David Souter	👍	A libertarian conservative, Souter has great regard for precedent. Has been a strong supporter of the First Amendment. Rumor has it he is also computer literate.
John Paul Stevens	👍	Considered middle-of-the-road. Wrote the 1978 *Pacifica* decision that upheld indecency standards for broadcast media but has resisted efforts to apply indecency standards to other contexts.
Clarence Thomas	👎 ?	A cultural conservative, Thomas's jurisprudence is considered rigid and formal. As with most cases that come before the court, his decision will probably follow Scalia's lead.

PHOTO: ARCHIVE PHOTOS

1956	IBM
1960	Westinghouse
1961	UPS
1962	ABC
1986	NeXt

A Designer's Designer

Paul Rand single-handedly invented modern graphic design in the US, and nobody was better at it. From his first job as magazine art director in 1936 to his latest trademark design 60 years later, Rand brought to his work an originality, clarity, wit – and above all, intelligence – that is rarely matched within the profession he spawned.

Rand wrote as well as he designed; any serious student of communications would be well advised to find Rand's writings and take them to heart. The quote below is the last paragraph of Rand's 1985 book, *A Designer's Art* (it's the one with the colored stripes on the spine).
– John Plunkett

Graphic design
which evokes the symmetria
of Vitruvius, the dynamic
symmetry of Hambidge, the
asymmetry of Mondrian;
which is a good gestalt,
generated by intuition or by
computer, by invention
or by a system of coordinates
is not good design
if it does not communicate.

– Paul Rand, 1914–1996

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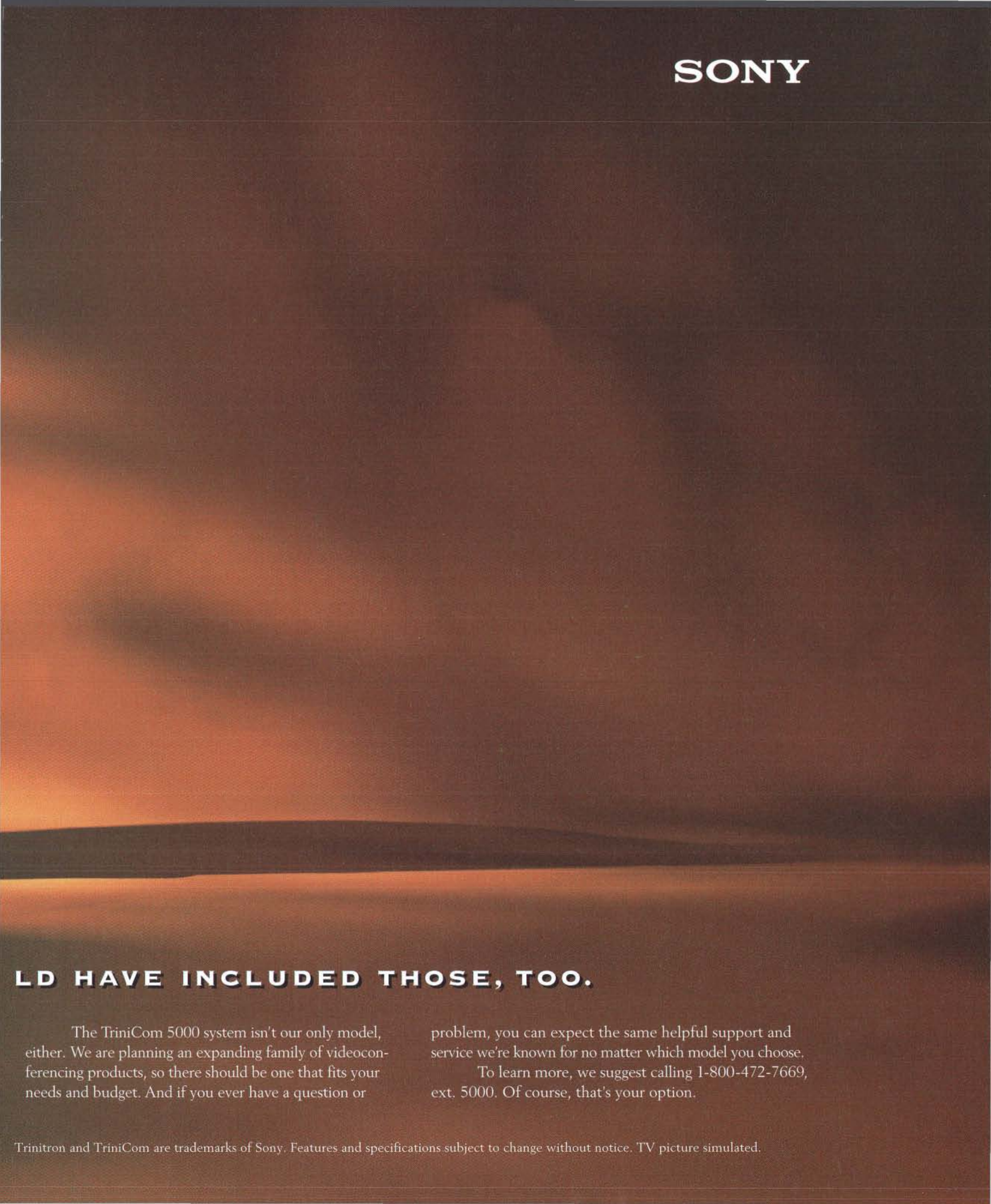

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People of the Chip

Whoever called them People of the Book probably never counted on the Jewish penchant for the PC. Forty-four percent of Israelis own a personal computer, which beats the bejesus out of the US.

Now the Israeli government hopes to bootstrap poor children by giving away 100,000 Pentiums. For a token fee, they'll throw in a color monitor, CD-ROM drive, 28.8 modem, Net access, training, and tech support.

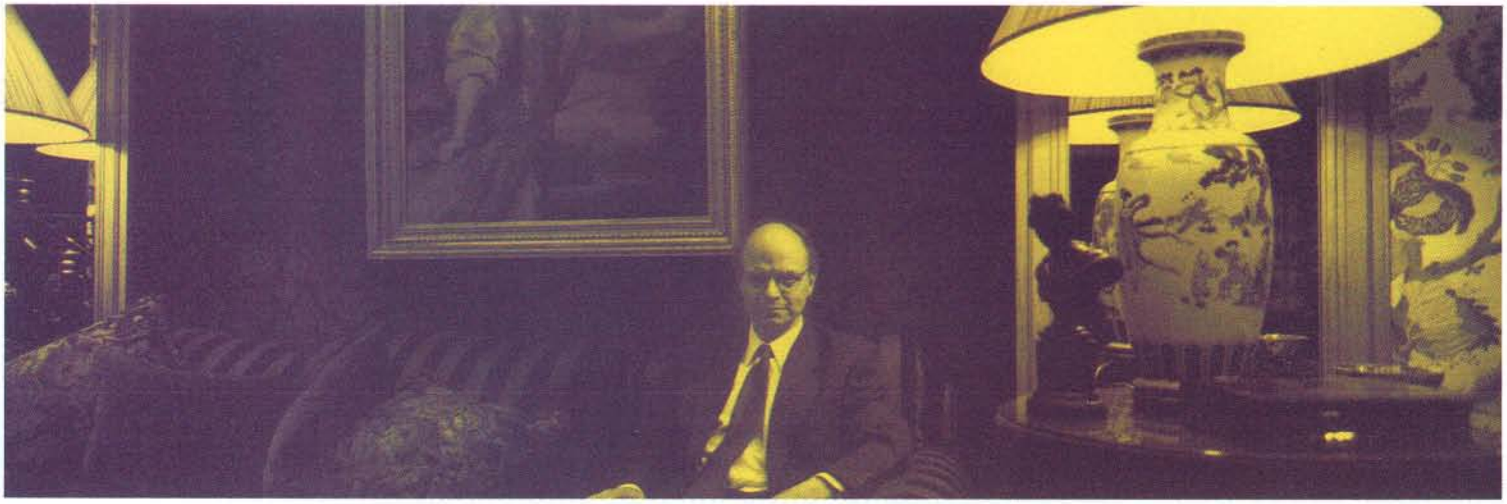
But not everyone is sanguine about the US$50 million initiative. Economic observer Sever Plotzker notes that free PCs won't address overcrowding, violence, and hunger.

"Maybe the most important thing," he writes, "would be to assure them a quiet home to study … to give them books, and then more books." - *Sheldon Teitelbaum*

► that looming large in your rearview mirror? Could it be … the New Economy? ≡III Low Security: The wonderfully named WarRoom Research LLC recently surveyed 200 of the Fortune 1,000 and found that nearly half have experienced computer break-ins this past year. Of those, about one-third claimed losses of more than US$500,000. Sounds ominous, no? Indeed. Had us reaching for the phone to call in the computer security experts until we noticed the survey was sponsored by … the computer security experts, including those interested in selling you computer security – IBM and Symantec. ≡III Wow! That Sucked! Poor CompuServe. It must be hard to watch America Online noisily eat your lunch. Earlier this winter, CompuServe cried uncle and killed Wow!, its pathetic attempt at an AOL killer. On a press release ingenuously titled "CompuServe Reports Expected Q2 Loss and Other Charges," CompuServe announced the death of Wow! and the launch of a more narrowly targeted service for business (read: high-margin) users. Seems CompuServe finally caught the clue that there's barely room for one mass ►

The Don of Dig Sigs

In digital signature circles (where verifying identity and the integrity of data sent on the Net is paramount), Alan Asay is known as the Godfather. Asay, who now works at CertCo, a company developing software for certified signatures, drafted the first digital signature act two years ago for Utah and set up legal and technical guidelines for authentication. This winter, more than 20 states are voting on or developing legislation based on Utah's blueprint. Along with imminent legislation in Europe and Malaysia, the upsurge in interest is a jumpstart for the smartcard and e-cash industries. A tireless champion for the cause, Asay says, "The lack of legal infrastructure is largely the reason this technology has been around for 10 years – an eon in techno time – but hasn't really gone anywhere."
– *Roderick Simpson*



ORIGINAL PHOTO ABOVE: JULES ZALON/IMAGE BANK; PHOTO BELOW: HERVE BERNARD

TIRED	WIRED
Martha Stewart Living TV	***Iron Chef***
Cell phones	**PCSs**
HMOs	**Medical savings accounts**
Liquid crystals	**Light-emitting polymers**
MHz	**GHz**
Evian	**Moon water**
The great Web	**The big push**
Charging subscribers	**Charging providers**
Philip Roth	**Thomas Pynchon**
No Doubt	**Olivia Tremor Control**

A Perfectly Private Marriage

It's an ideal match – better than JFK Jr. and Carolyn, more titillating than Michael Jackson and his bride-of-the-month. In cyberspace, the marriage of the year is Pretty Good Privacy Inc. and PrivNet.

In November, PGP – the company that distributes Phil Zimmermann's famous email encryption program of the same name – announced that it was acquiring PrivNet, a tiny North Carolina-based software start-up. PrivNet made a name for itself in mid-1996 by releasing a freeware program called Internet Fast Forward that filters out ad banners and cookies on the Web – all in the name of enhancing Internet user control.

The union establishes PGP as a leader in Internet privacy products, extending its reach from email to all forms of electronic communication. "We've always worshiped Phil Zimmermann as a Net god," says Gene Hoffman (right), a PrivNet cofounder. "Now we're finding that he's a great boss, too." – *Todd Lappin*

► McMarketed online service, let alone two or three. ≡III Black Copters at Microsoft: Bill devotee Bob Loblaw has been staring at his Windows 95 start-up screen a bit too long. An excerpt from his homepage, Subliminal Messages In Windows 95? *(tcp.ca/gsb/PC/Win95-subliminals.html)*: "If you imagine that the upper-right corner of the Windows logo points to the back of a guitarist's neck, you can see that the guitarist has curly hair, a mustache, a clearly visible frilly collar, and is playing with his head back and his elbow at approximately the area where the green and the yellow rectangles meet. With a little more effort, it's not hard to imagine that this afro-haired, mustachioed guitar hero could be none other than Seattle-area rock legend, Jimi Hendrix." ≡III No Glory: Anyone who's read Japanese pulp novels about ►

Prime Time

When George Woltman began his search for the largest known Mersenne prime number – used in cryptography algorithms – he decided to enlist the help of the entire planet.

The last Mersenne record holder used a Cray supercomputer and weeks of processing time. Woltman (right) simply created a Web site *(ourworld.compuserve.com/homepages/justforfun/prime.htm)* where people can download a program that checks for primes and sign up for numbers to investigate.

By last November, there were more than 750 people working on the problem. That's when French computer programmer Joel Armigaud hit pay dirt. On November 23, he announced to the world that he'd found $2^{1398269} - 1$.

Since the discovery, volunteers in growing numbers have been working to automate the project. "I don't know how far it'll go," says Woltman, who seems OK with relinquishing control to the hive mind. "I hope it'll take on a life of its own." – *Andrew Rozmiarek*

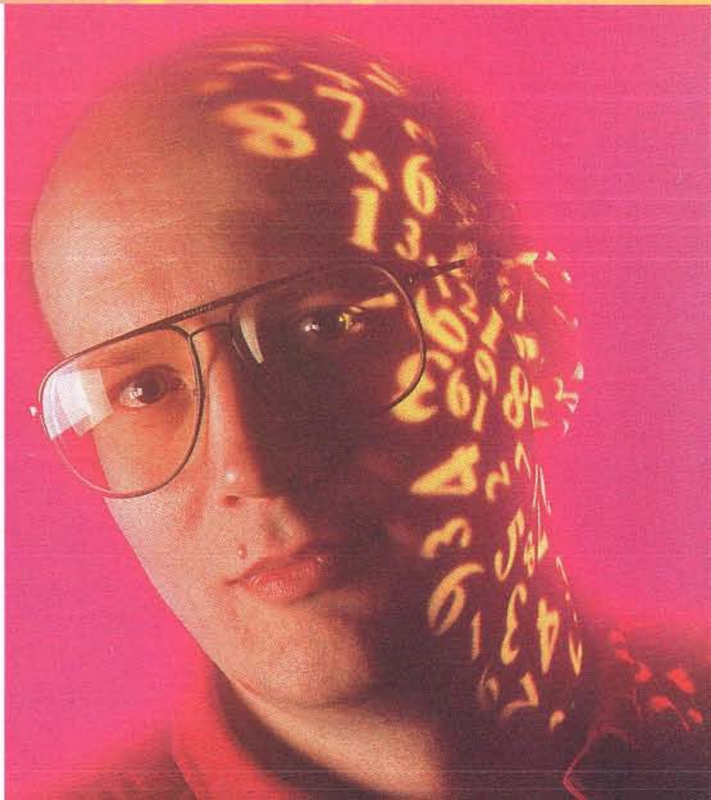


PHOTO BELOW: JOHN PETREY

May I Help You ... Get Online?

Tired of pounding the tiles in search of the perfect Valentine's gift? Virtual Emporium has the answer: visitors to its Santa Monica, California, virtual mall can select from more than 2 million products by browsing at one of 30 PCs (the store mirrors its Web site at *www.vemporium.com/*). In-store specialists cheerfully help newbies, whose consumerism is enhanced by T1 lines and SSL purchase encryption. From Speigel to L'eggs and BMW, VE's retailers run the gamut.

"We've combined retail and technology in a way that demystifies the Internet and gives customers a sneak preview of what shopping might look like in three to five years," gushes Tuck Rickards, VE's founder and CEO. "We're going to change the way people shop."

Pardon me ... but where's your virtual rest room? – *Colin Berry*

► WWII knows that country's predilection for, er, bending the facts when it comes to military success. But Chinese authorities would have none of it when such tendencies spilled into a software game, *Governor's Decision* from Glory Software Co. Ltd. Seems the Chinese took offense at Glory's distortion of history and glorification of Japanese military aggression against China. Besides seizing all discs, the authorities have fined the company more than US$50,000 and forced it to submit a "self-criticism." We'd love to read a copy of that.

Born to Rebel?

When Mao Zedong was asked his assessment of the French Revolution, the chairman replied, "It's too soon to tell."

Perhaps it was too soon because Frank Sulloway hadn't yet published *Born to Rebel,* the culmination of 26 years of research showing that the French Revolution, like the Darwinian revolution, was driven not by class conflict but by sibling rivalry. Sulloway's complex study, which considers many factors such as gender, age differences, and family disruptions, hypothesizes that firstborns are apt to oppose societal change while laterborns tend to push for more.

We asked the laterborn MIT scholar to comment on a few digital luminaries. – *Bill Brazell*

Firstborns

Steve Jobs (Apple cofounder; shown left) "He embodies a litany of firstborn traits: brash, determined, ambitious – take the way he approached Hewlett-Packard at age 13 to ask for spare computer parts."

Charles Babbage (inventor of Analytical Engine) "Here's a guy who set out to eliminate error from the world and invents a machine that founders in grandiose ambitions. What a formula for a firstborn life in science."

Theodore Kaczynski (accused Unabomber) "A fantastic case – he is reputedly a violence-prone reactionary who wants to return to a technology-free past. And his younger brother is an archetypical laterborn – a vegetarian who counsels youth. The press really missed the point of this story."

Steven Spielberg (filmmaker) "Spielberg is a daring and imaginative filmmaker. If I didn't know he was a firstborn, I wouldn't have guessed it."

In between

Esther Dyson (publisher of *Release 1.0*) "Dyson is a secondborn who became a functional firstborn at age 6. John Markoff said of her that 'she really can't find her niche,' which is the description I would have used. She's turned an adversity into a strength."

Laterborns

Bill Gates (Microsoft cofounder) "The most revolutionary thing Bill Gates did was not to found Microsoft, but to drop out of Harvard against the wishes of his parents."

Vannevar Bush (architect of the Manhattan Project) "He dropped out of Tufts because his mentor wasn't studying his field – a laterborn is much more likely to be rankled at the loss of independence."

Marvin Minsky (artificial intelligence pioneer) "His 'society of mind' theory is a laterborn worldview – firstborns always have a one-world, one-mind view. Laterborns react against this."

George Lucas (filmmaker) "Having started off as a sort of anticonformist, with *THX-1138*, and gone on to show an eclectic taste, Lucas fits as a laterborn."

www.honda.com

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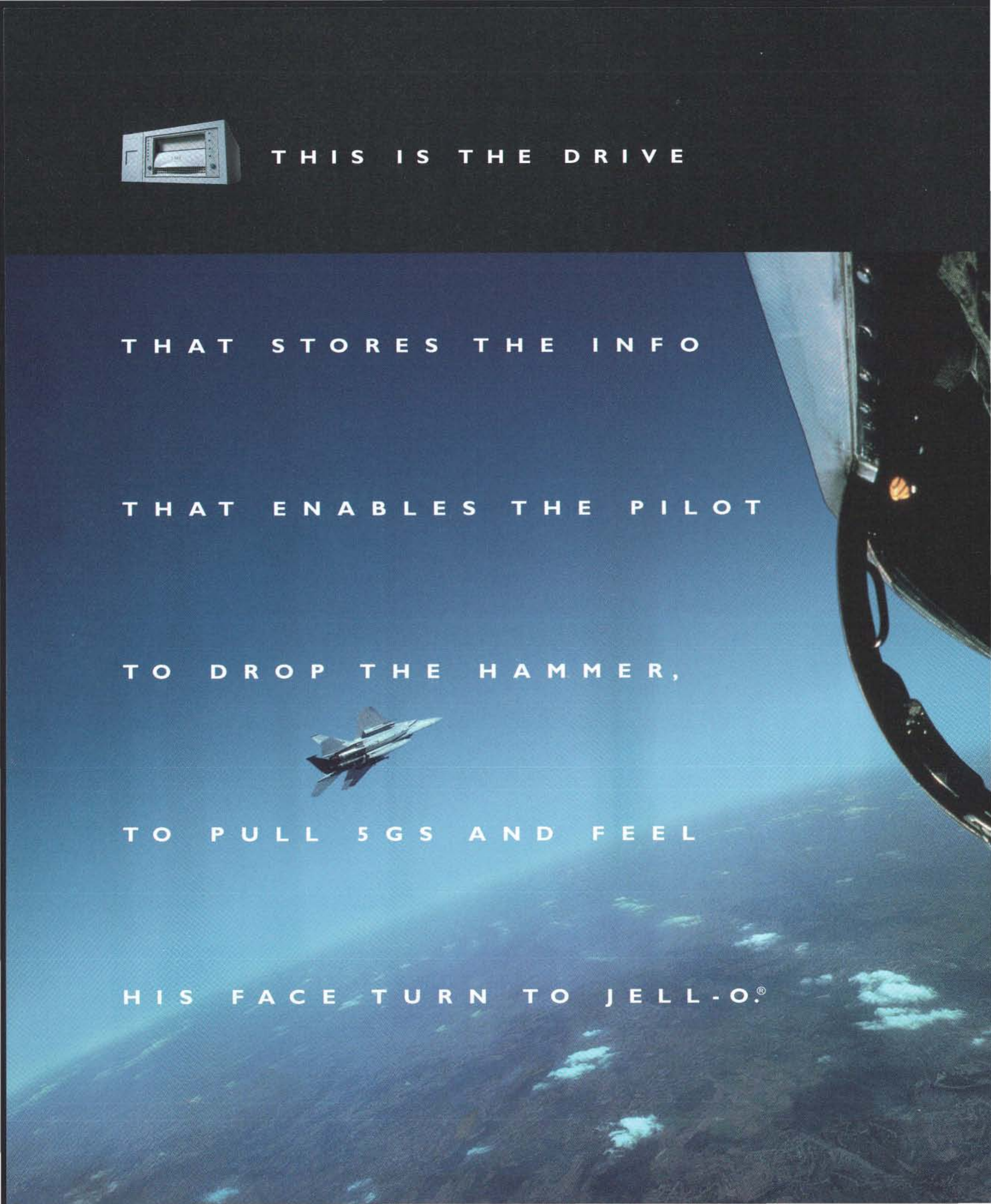
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Greyscale Levels	4,096	1,024
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Color (4x5)	21 seconds	27 seconds
Grayscale	23 seconds	33 seconds
Text OCR	14 seconds	28 seconds

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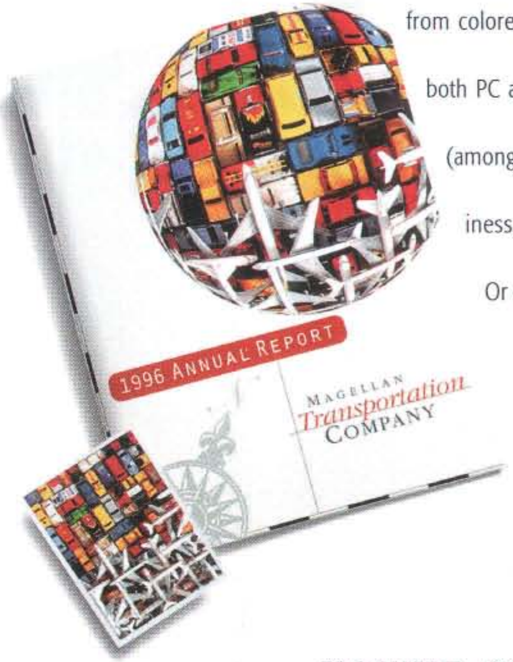

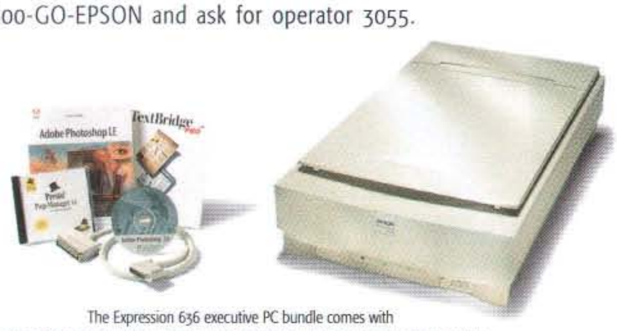

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THE NETIZEN

The Great HDTV Swindle

Broadcasters are trying to make money the way they always have – by getting the government to give them free bandwidth and rigging the regulations in their favor.

By Charles Platt

www.wired.com/5.02/netizen/

A dazzling new wave of high technology entertainment seemed suddenly poised to sweep the nation. On November 25, 1996, FCC chairman Reed Hundt announced a standards agreement between TV broadcasters, manufacturers, and the computer industry that would enable them to "start planning huge new worlds and uses of TV in the digital age."

Major newspapers suffered a strange collective lapse of critical faculties and blindly accepted Hundt's spin on the story. *The New York Times*, the *Los Angeles Times*, and *The Wall Street Journal* all ran upbeat features previewing imminent giddy treats such as photo-quality TV pictures, Web compatibility, data transmissions, and interactive services. But behind this hype lies something much uglier that has received virtually no publicity: a saga of procrastination, protectionism, political favors, and outrageous greed.

In fact, the FCC has done almost as little to revolutionize television as the pope has done to promote birth control. If you really think your local TV station is gearing up right now to start transmitting high-definition pictures, you're going to be disappointed. For years to come, most viewers will be stuck with the same old video format they're watching today – because broadcasters will have no incentive or legal requirement to transmit anything better.

There's one simple reason for this: the Federal Communications Commission has allowed the big beast that is the broadcasting industry to dig in its claws, refusing to modify its posture or moderate its feeding habits despite a decade of begging, bluster, and bribes. The new standard for digital television is so minimal, it meekly permits TV stations to continue transmitting the low-quality color that Americans have been watching since the days of vacuum tubes.

Hundt's public statements imply that television is being opened up to the cold winds of competition in a free market where consumers will call the shots. As he put it in a recent press release, "Our goal has been to trust the market, not government, to define the digital television of the future." Yet broadcasting is still a closed fraternity, licensed and protected by the FCC.

Even worse, the new transmission standard will allow TV station owners to start reaping huge new profits by selling additional pay services, using spectrum they were allocated originally at no charge – because the US government naïvely trusted them ►

Charles Platt's "Evolution Revolution" appeared in Wired *5.01.*

to "serve the public interest." This opens the door for the most outrageous abuse of public airwaves since the dawn of radio.

How has this happened, why haven't you heard about it, and why won't your TV screen look any different tomorrow from the way it looks today? The roots of the scandal are buried in events that started to unfold more than 20 years ago.

Back in the early 1970s, the Japanese broadcasting company NHK started studying ways to upgrade picture quality. Originally the Japanese had adopted America's TV format, which was devised by the National Television Systems Committee in the 1940s. The NTSC specified a 525-line picture in a 4:3 aspect ratio, the same shape as an old movie screen. Color was added in 1953, but that was the last major upgrade, and an NTSC picture is what you still see today when you watch broadcasts, cable, or any other source of American video. Clever circuitry has improved the color in modern TVs, but there are still only 525 scan lines, and the format cannot display fine detail - which becomes obvious if you ever try to read the small print on those car leasing commercials.

NHK proposed a new system of high-definition television (HDTV) with twice as many lines on a wide screen. The company's motives, however, seemed more wrapped up with money than quality. NHK is government-owned and financed by user fees, which are collected from consumers as a form of taxation. "NHK projected that its production cost for programs would rise faster than it could raise the license fees," comments Andrew Lippman, an associate director of MIT's Media Lab, who initiated its advanced television research program. According to Lippman, the Japanese broadcaster saw HDTV simply as a ploy to balance its budget, since a fancier picture would legitimize higher fees.

The concept excited Japanese TV manufacturers, which had saturated the global market and were looking for a way to stimulate new demand. The Japanese government also liked HDTV because it offered an opportunity to set a world standard, which would enhance national prestige. And so, right from the start, greed and nationalism tainted the simple goal of transmitting better video.

In Europe, TV manufacturers such as Philips of Holland and Thomson of France took immediate steps to protect their turf. "HDTV was Japan's ultimate weapon," a Thomson executive has been quoted as saying, "an instrument with which to squeeze their European competitors and ... move in for the kill."

How could the Europeans fight back? Simple: by creating an incompatible standard. Nine countries quickly banded together and raised more than US$1 billion in government and industry funding to develop their own kind of HDTV, thus defending themselves against a Japanese invasion.

Meanwhile, in the United States, no one was really interested in HDTV. Most television manufacturers had already given up trying to compete with Sony and Matsushita, and most broadcasters saw no reason to spend millions of dollars to upgrade their cameras, tape equipment, and transmitters. Why should they bother? A better picture wouldn't bring in any extra advertising revenue.

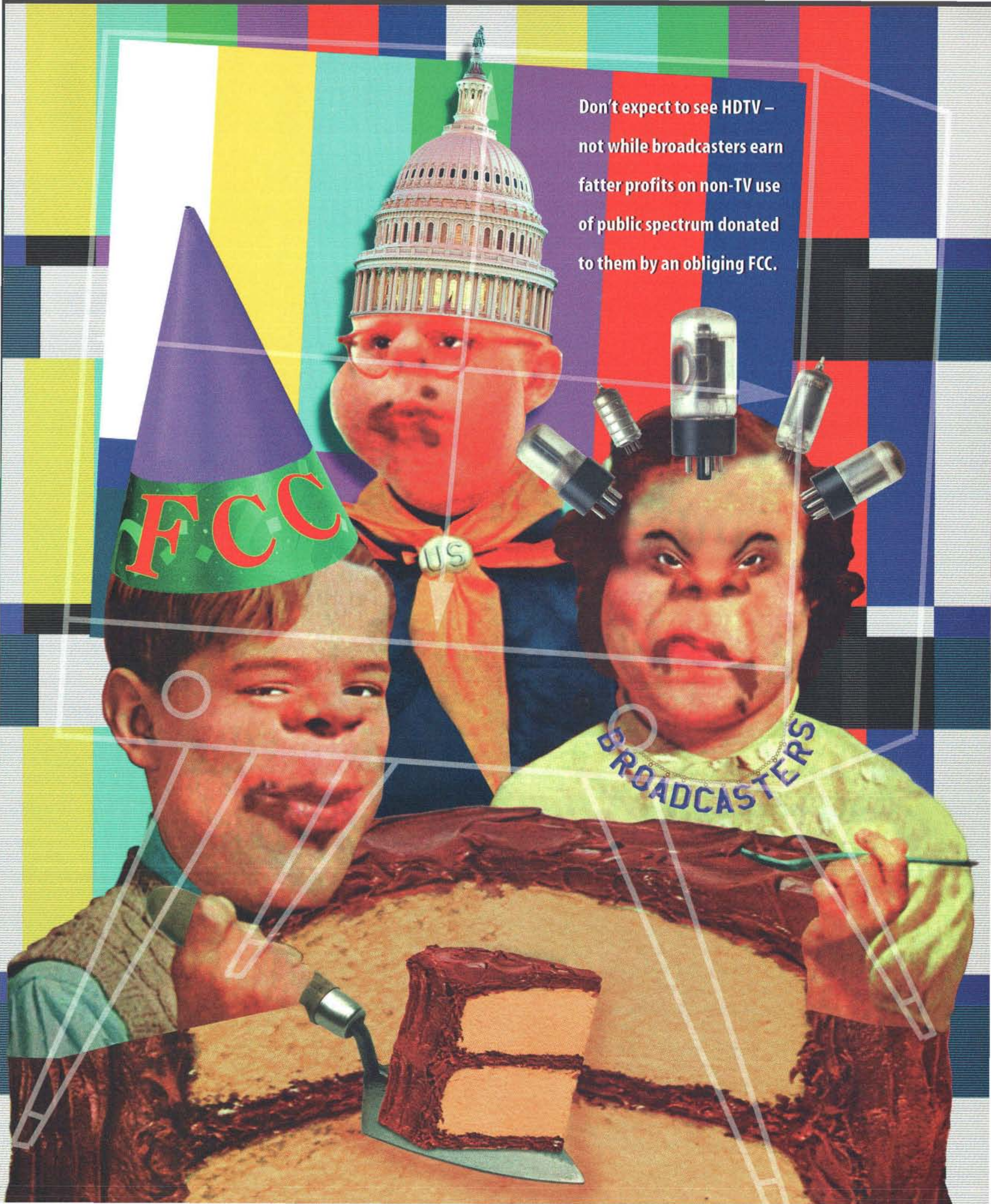
Of course, if television had been a free market, an enterprising corporation could have introduced HDTV to position itself against aggressive new competitors. This is precisely what IBM did in the computer business when it introduced VGA graphics in response to clone manufacturers that were starting to nibble the PC market. But in the government-controlled business of over-the-air broadcasting, the VHF waveband allows no room for new competitors, and TV stations aren't allowed to transmit unapproved formats anyway. Consequently, American consumers remained uninformed about HDTV, and broadcasters were safely able to ignore it - until the 1980s.

At this time, American fears of Japanese economic prowess were at their height. The Japanese had been doing HDTV demos; it was a reality that couldn't be ignored, and America didn't have it. There was a TV gap, just as there had once been a missile gap. National prestige was on the line. How should the country respond? Obviously, by establishing yet another new, incompatible standard.

Congress told the Federal Communications Commission to take care of it. The FCC has the same kind of fearsome power over broadcasters that the Federal Aviation Administration wields over airlines: in addition to establishing regulations, it issues broadcasting licenses - and can take them away. The commission now had the power to choose a standard for HDTV and force broadcasters to use it.

But possessing power and exercising power are very different things. In 1987, the FCC issued a tentative "notice of inquiry" about HDTV. It waited about a year for industry to respond, then set up the FCC Advisory Committee on Advanced Television Service to prepare some deeper studies. Thus began a slow-motion process of proposals, counterproposals, discussions, ruminations, and recommendations that has lasted all the way through to 1997. During this period, over-the-air broadcasters, direct satellite broadcasters, TV networks, TV manufacturers, cable companies, consumer groups, and programmers have warred with each other, wrestling to mold and exploit HDTV, while the FCC has sat on the sidelines like a permissive parent at a birthday party, passively watching a bunch of bad-man- ►

ILLUSTRATION BY LOU BEACH



Don't expect to see HDTV – not while broadcasters earn fatter profits on non-TV use of public spectrum donated to them by an obliging FCC.

nered kids fighting for the biggest pieces of cake.

The long wait for HDTV did create one positive benefit: technology matured, enabling television to go digital. An HDTV picture contains far more visual data than an old-style NTSC picture, because the screen is wider and the image is more detailed. At first no one could see a way of transmitting all this data through a traditional TV channel, which has a bandwidth of just 6 MHz. It was like trying to force four times as much water through an old, small pipe.

But if a picture can be digitized, it can be *compressed*. For instance, instead of transmitting all the pixels of a plain blue sky, you can send a code saying, "Paint the next 5,000 pixels blue." And if the sky doesn't change during a series of video frames, you can send a code saying, "Keep the sky the same as before." You can also use clever algorithms to average out color variations in ways that are almost imperceptible to the human eye. At the receiving end, a suitable new, improved, digital TV set can be smart enough to understand these coded instructions, decompress the signal, and turn it back into the original picture.

For years to come, TV viewers will be stuck with the same old video format they're watching today – because broadcasters will have no incentive to transmit anything better.

The only problem is that consumers can't view a digitized transmission unless they buy that new, improved TV set. With this in mind, the FCC proposed a transition period during which broadcasters would send the old format and the new format simultaneously. How could they do this? With permission from Congress, the FCC agreed to loan each broadcaster one extra channel in the UHF spectrum to carry the new digital signals. After 10 or 15 years (to give consumers time to buy new TVs or digital decoders for their old ones), NTSC color would be shut down permanently, and HDTV would become the new standard, and at that point each broadcaster would return the extra spectrum that it no longer needed.

This seemed fair enough, but some consumer groups were outraged by the idea of networks and TV stations receiving extra free channels just so they could transmit the same old trashy programs in a wide-screen format. "To let broadcasters receive this enormous benefit without imposing any new obligations in exchange would be the biggest corporate welfare giveaway of the decade," ranted Gigi Sohn of the Media Access Project, testifying before the FCC.

Groups such as hers seemed to feel that high-definition pictures were just a status symbol for decadent gadget freaks. They wanted to force broadcasters to upgrade their content in exchange for the loan of extra channels – or scrap HDTV altogether and auction off the extra UHF channels right away. According to FCC estimates, this could raise somewhere between $11 and $70 billion, which could be spent on suitably deserving causes. PBS, for instance, politely mentioned that it could certainly use some extra money to create more socially edifying TV series.

But whose interests were the consumer groups really serving? They seemed to assume it would be "right" to compel networks to offer more educational, "quality" programs – but this meant dictating what viewers should be allowed to see, instead of giving them the chance to choose for themselves. In fact, right from the start consumers had been excluded from the HDTV debate, and all the combatants seemed happy to keep it that way.

Meanwhile, digitized TV had some mind-boggling implications. If the huge amount of data in an HDTV transmission can be squeezed into one old-fashioned 6-MHz channel, consider what can be done to a low-quality NTSC picture if it, too, is digitized and compressed. It can be reduced to as little as 1 MHz, leaving 5 MHz of a traditional channel "spare."

This was an intoxicating concept. Suppose the broadcasters could wriggle out of their obligation to transmit HDTV, and suppose they could get permission to continue using plain old NTSC – while transmitting it digitally, so it could be compressed. They'd still be able to use most of their existing video equipment, while magically acquiring 5 MHz of "spare" bandwidth! They could fit five or six compressed channels into the space formerly occupied by just one!

This was like a landlord realizing he can subdivide a house into six apartments, charge six times as much rent, *and* get an exemption from real estate taxes. Would the FCC allow such wild profiteering? There was surely no precedent for it, and no principle that could legitimize it; yet Reed Hundt seemed to find it acceptable. Speaking in New York in September 1996, he said that "digital TV should not be straitjacketed by a government mandate requiring a single channel of HDTV per license. If the American people want more channels, and broadcasters can afford to provide them over a digital signal, government shouldn't stand in the way."

But if the FCC wasn't going to force broadcasters to fill each channel with a big HDTV picture, HDTV wasn't likely to happen. Michael Grebb, an associate editor of DC-based *Telecommunications Reports* (which charges $1,295 per annual subscription for insider gossip and plain-English summaries of complex federal regulations), is a veteran FCC watcher. "If the government doesn't require that broadcasters

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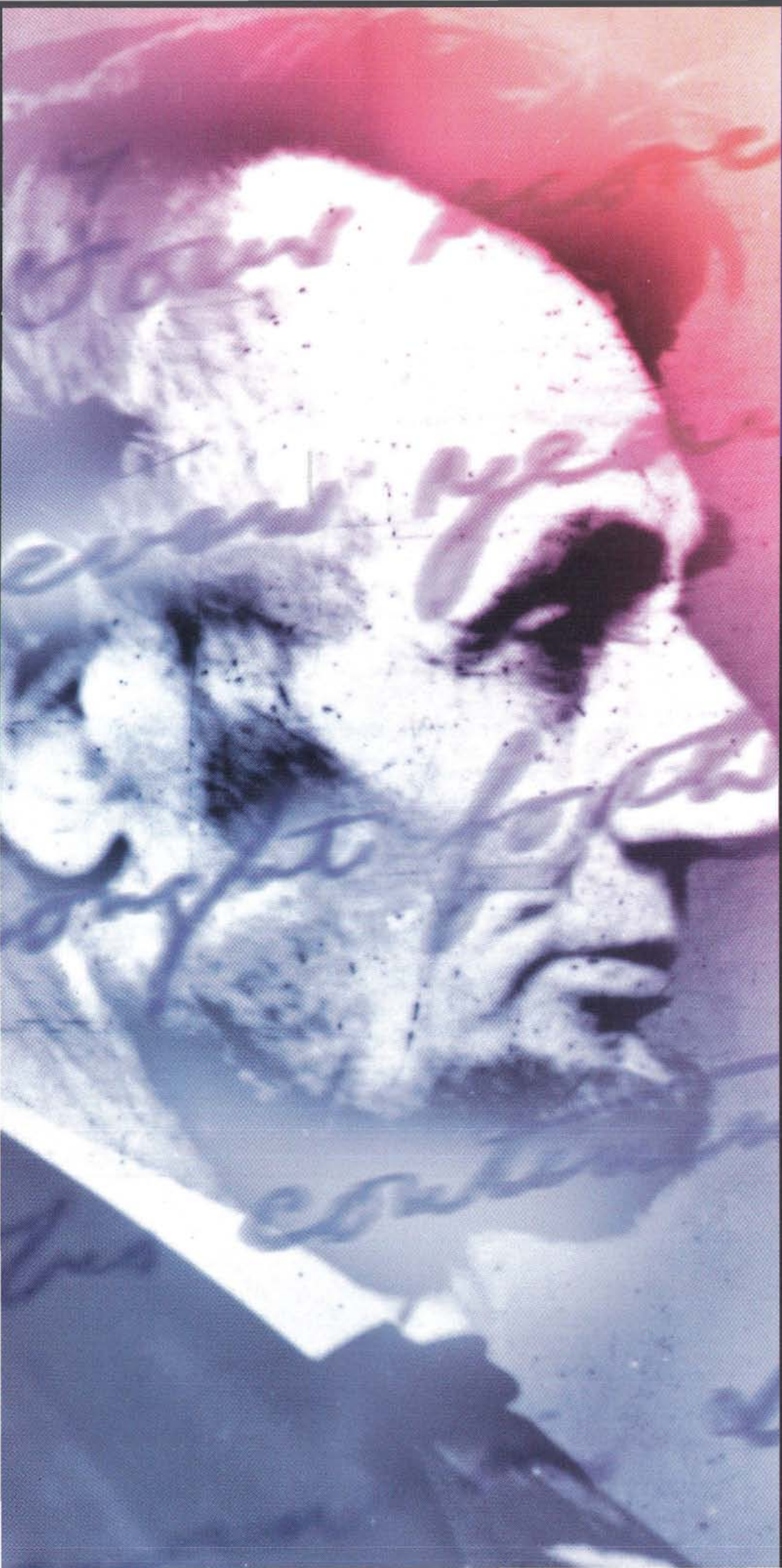

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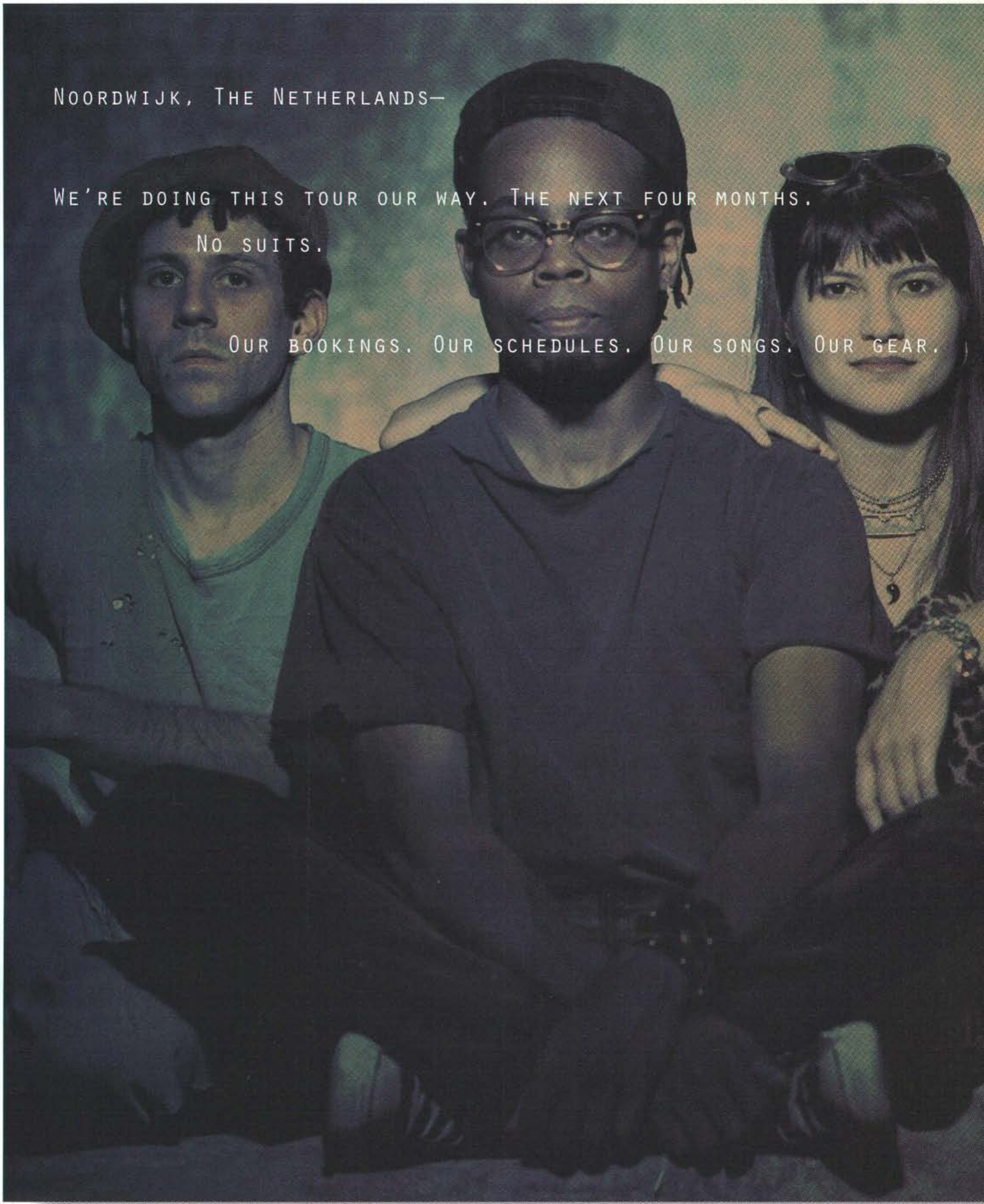
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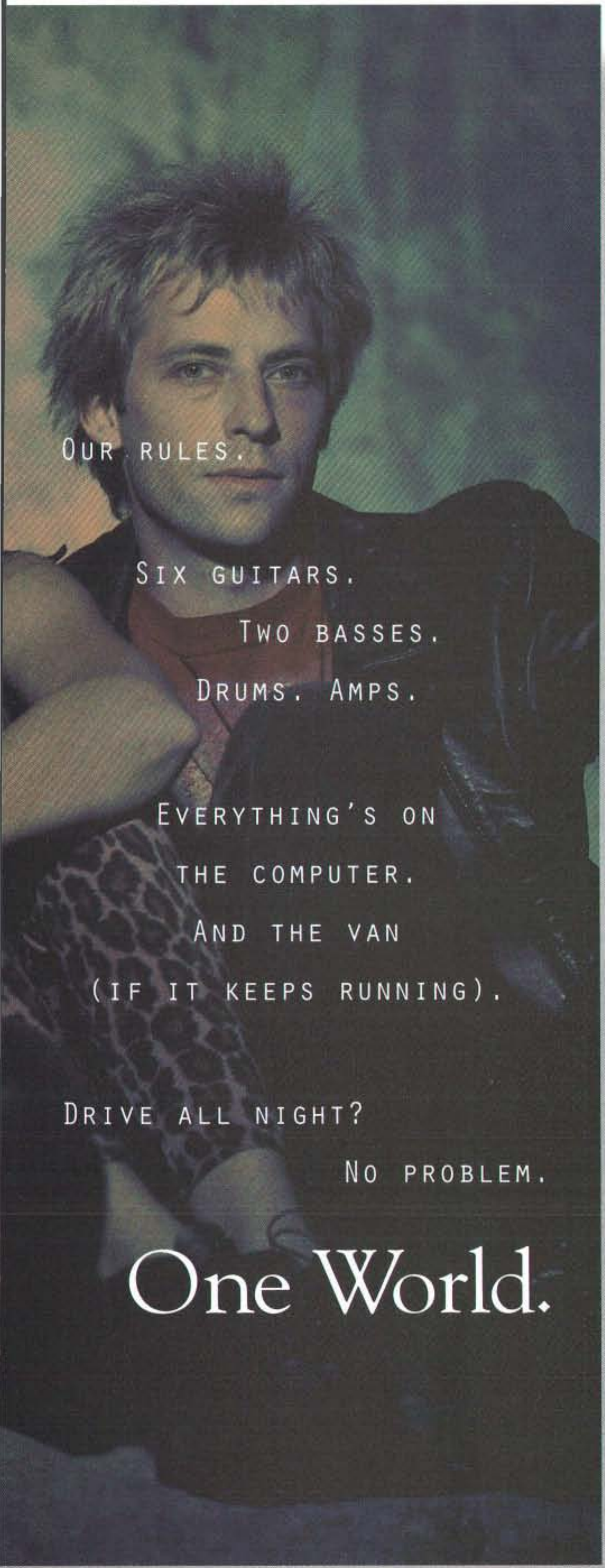
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FETISH

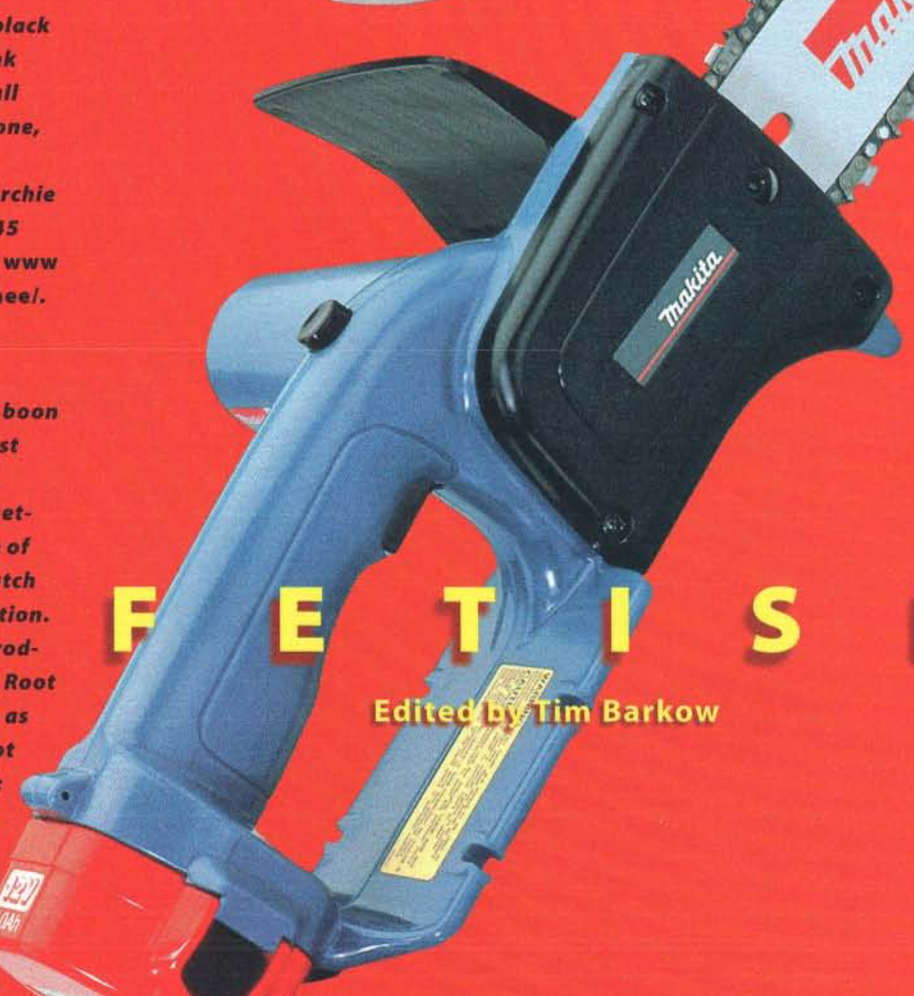
Edited by Tim Barkow

Prick

For most people, the computer remains a mystical device whose inner workings only tech support really understands. How do the geeks get by? With Voodoo, of course. The great thing is, you can prevent crashes with white pins or – if you've got theater tickets – cause one with the black pins. You didn't think tech support fixed all those computers alone, did you? Computer Voodoo: US$6.50. Archie McPhee: +1 (206) 745 0711, on the Web at www.halcyon.com/mcphee/.

Chaw

Brewing up tea as a boon to your manhood just too femme? At last there's a means of getting your daily dose of ginseng that's as butch as the root's reputation. Vermont Ginseng Products has introduced Root 100 Ginseng Chew – as in chaw, pardner, not gum – in six flavors: cinnamon, peppermint, ginger, wintergreen, tangerine, and original. Go for the original. The cinnamon tastes like rancid apple pie; as for peppermint – well, you can see how a combination aphrodisiac and breath mint might find a market. Root 100 Ginseng Chew: US$6.50 per tin. Vermont Ginseng Products: (800) 270 0007, +1 (802) 244 4372.



Ripping

Leading a life of digital drudgery could force a person far into the wooded hills for the sake of sanity. But if you're planning to escape anytime soon, better trade in your desktop geekware for Makita's new 12-volt cordless chainsaw. (Yes, cordless. Can't expect to go cold turkey right from the git-go.) The UC120DW weighs 3.8 pounds, will handle lumber up to 4.5 inches thick, and is just over a foot long. It's a perfect accessory for the not so environmentally acclimated. UC120DW: approximately US$299. Makita USA: (800) 462 5482, +1 (714) 522 8088.

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You spend too much time at your desk – that you know. But how many minutes a day do you spend walking? With the Comp-U-Hike, you'll know. This pedometer keeps track of miles and kilometers, plus steps walked, calories burned, even the length of your workout. Its light design and easy-to-read LCD will keep you focused on the task at hand. Plus the Comp-U-Hike includes a 10-hour stopwatch and a compass to help you find your way back (in case you really don't get out much). Comp-U-Hike Pedometer: US$40. The Nature Company: on the Web at www.natureco.com/.

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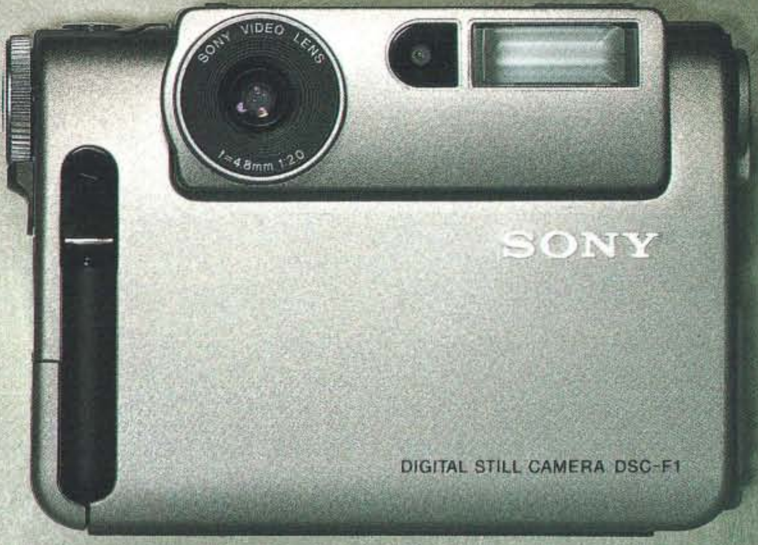
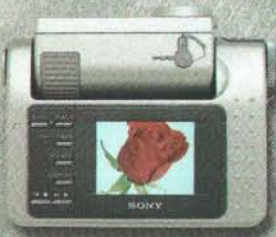


Oh-la-la, make room in your imagination for the pocket-size Sony DSC-F1. Then simply aim, shoot and save up to 108 sharp, clear pictures for instant downloading of your creative genius. The DSC-F1's all-encompassing list of features includes a LCD screen for instant review, wireless* transfer of images, and of course, Sony's leading CCD technology for outstanding image quality. Making it the crème de la crème of digital cameras.



Integrated LCD screen.

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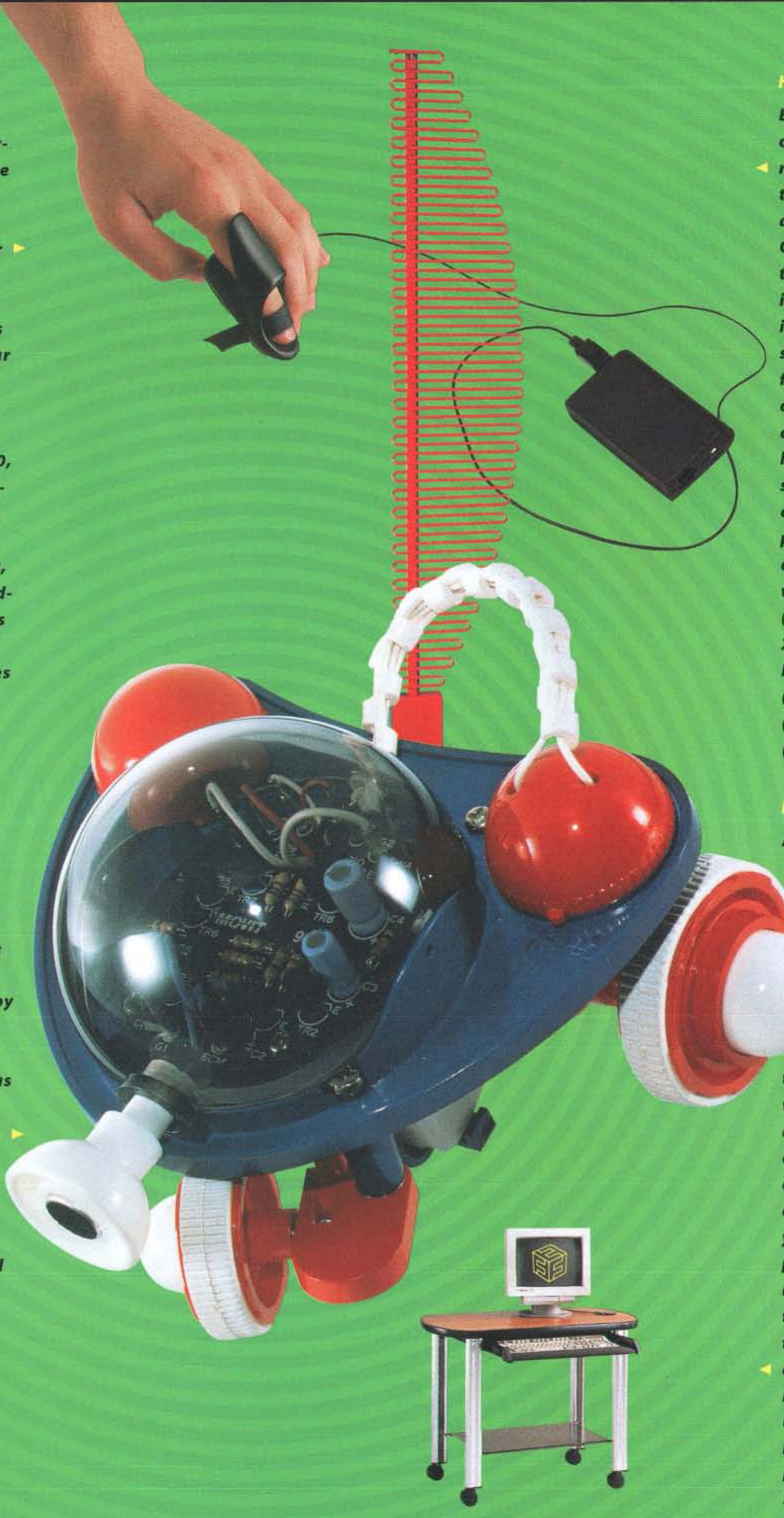
Lazy

Tapping into the serious-couch-potato entertainment market – those game junkies who get tired just holding on to the joystick – The Other 90% Technologies has developed MindDrive. The sensor sleeve reads electrical signals in your index finger and translates them for your PC. You'll need a computer with a 486 CPU, DOS 5.0, and a double-speed CD-ROM drive. Eight available titles let you play games, ski down slopes, or compose music. MindDrive: US$149.95; titles $29.95 to $39.95. The Other 90% Technologies Inc.: (800) 706 0456, +1 (415) 460 1010.

Bubblehead

Perhaps toy robots haven't caught on because their purpose isn't all that clear and what they do isn't all that brilliant. But come on, people – they're robots! The Hyper Peppy has nothing on Robbie the Robot, but its awkward shape and bulbous head hide the circuit guts of a speed demon. Peppy features touch and sound sensors that change its direction of motion when contact or a loud sound is made. No kid should pass through life without one. And it beats another trip to Toys'R'Us for more Power Rangers gear. Hyper Peppy: US$24.95. The Exploratorium Store: +1 (415) 561 0393.

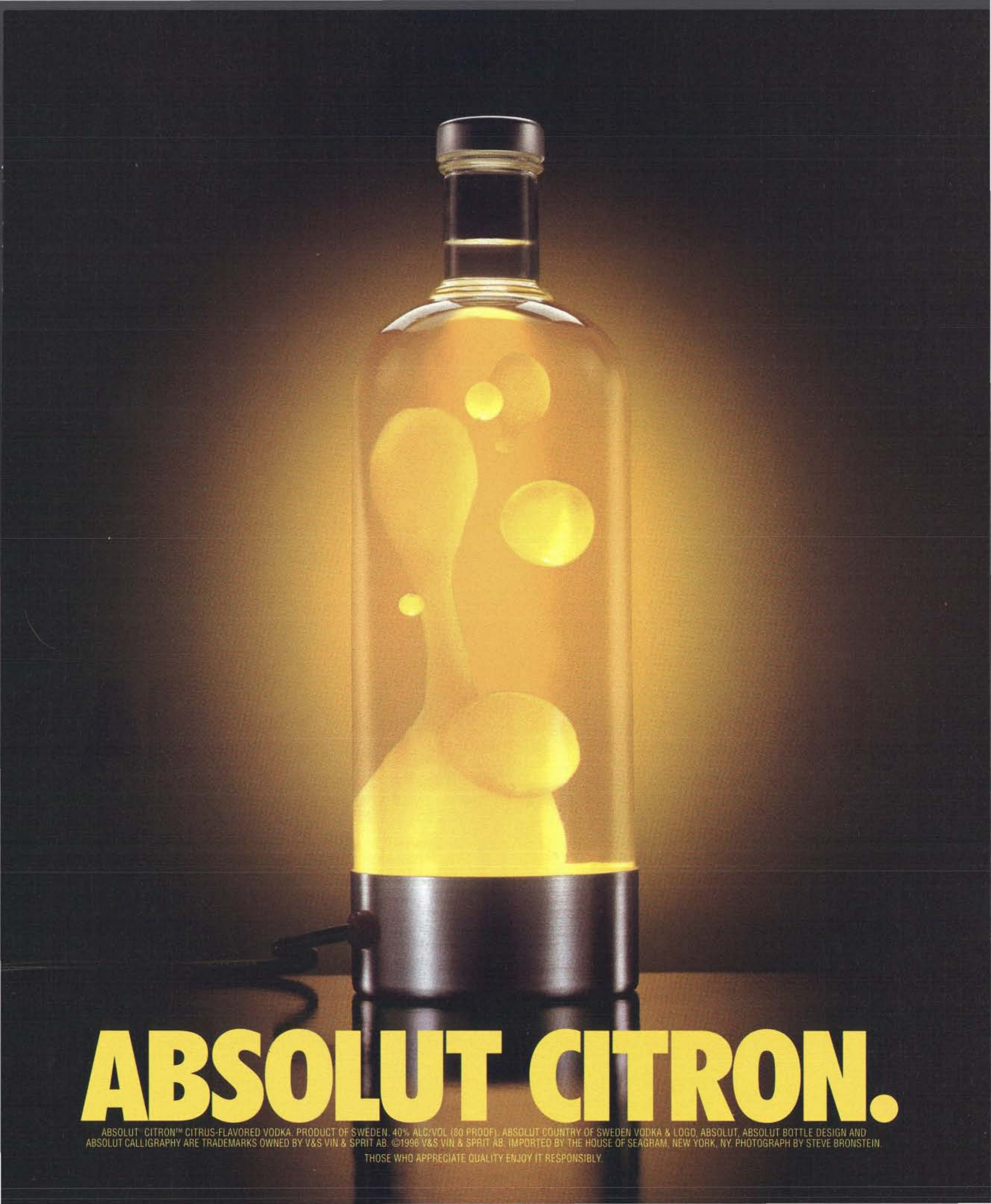


Heatwave

Ever the ugly ducklings of home furnishings, radiators are generally tucked away in nooks and crannies. But Focus Contemporary Radiators, swans of the heating pond, beg to preen in open spaces, to be seen by all. These colorful (sorry, traditional oatmeal not available) and cleverly named heaters come in elegant sizes and shapes – from curvy to angular – complementing your home's decor. Circulating water warms Rising Moon (pictured), which stands 2,350 mm by 450 mm. Rising Moon: ƒ5,354 (US$1,025). Focus: +33 (4) 67 55 01 93, fax +33 (4) 67 55 77 77.

Rolling

Apartment too small to fit a dessert table and a computer stand? Knoll's Propeller Rolling Cart, with its fashionable aluminum legs and wood veneer tops in 11 varieties, takes on both roles with ease. While typing at the computer, you can lock the cart's casters and hide electric cords in the legs. When your guests arrive, simply slide the keyboard under the tabletop, throw the monitor in the closet, and dish out the lemon mousse. Propeller Rolling Cart: US$630; optional keyboard drawer $160. Knoll: (800) 445 5045, +1 (212) 343 4000.



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THOSE WHO APPRECIATE QUALITY ENJOY IT RESPONSIBLY.

Connected

***AT&T's PocketNet Phone** is almost as good as a laptop – and much smaller. Using the CDPD network, the device sends and receives short email messages to and from anyone with a Net connection. Filtering out graphics and multimedia, it can access Internet servers to provide information on weather conditions, airline arrival times, stock quotes, even descriptions of how to get across town on the bus. The PocketNet Phone can also connect to your corporate intranet. Oh – and it makes phone calls. **PocketNet Phone:** approximately US$500. **AT&T Corp.:** (800) 552 3373, +1 (206) 803 4020.*

Rearview

*Worried about job security? Can't shake the feeling that HR is sneaking up behind you, wielding a big shiny ax? Keep tabs on your back while maintaining a productive, forward-looking attitude with the **ViewPoint**, a 3/8-inch mirror that attaches inside your glasses. The mirror is mounted on an even smaller ball-and-socket joint – allowing it to work with a variety of eyewear designs – that provides an ample wide-angle view. They can't get you if you get them first. **ViewPoint:** US$10 (package of two). **CycleAware:** (800) 252 2927, +1 (408) 685 1115.*

Cook

*The paperless kitchen is here. **Brother's Kitchen Assistant** is an indispensable database: the tiny unit stores recipes, gives half and double portions, calculates the amount of fat per serving, and prints out shopping lists. With memory expansion cards, you can swap cooking hints with your neighbor faster than you can gossip over the fence. **Kitchen Assistant:** US$349. **Brother International Corp.:** (800) 284 1739, +1 (908) 356 8880.*

Eats

*The **Think! Interactive Bar** – with a blend of chamomile, L-arginine, and* Ginkgo biloba *– claims to promote calmness and stamina as well as increase concentration while quelling the rumble in your stomach. The creators at P.H.D. (that's Personal Health Development) package their peanut-butter chocolate and chocolate, almond, and coconut bars with wrappers picturing a mouse and keyboard. **Think!:** US$1.49. **Personal Health Development:** on the Web at* www.thinkproducts.com/.

Thanks to Megumi Ikeda, Anne Speedie, Mandy Erickson, Ken Kinoshita, Tadashi Ibi, Steve Silberman, and Wired Japan.

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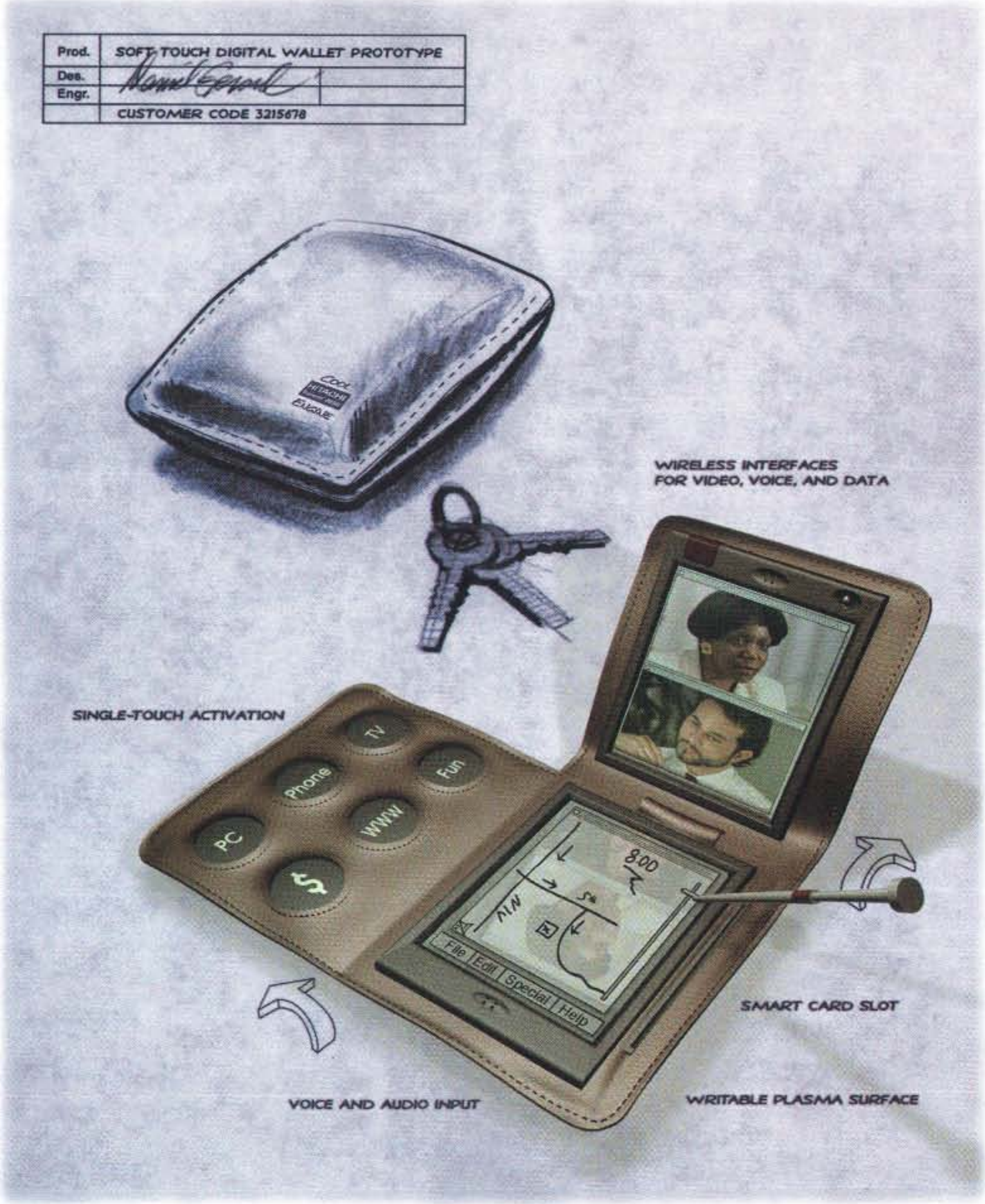

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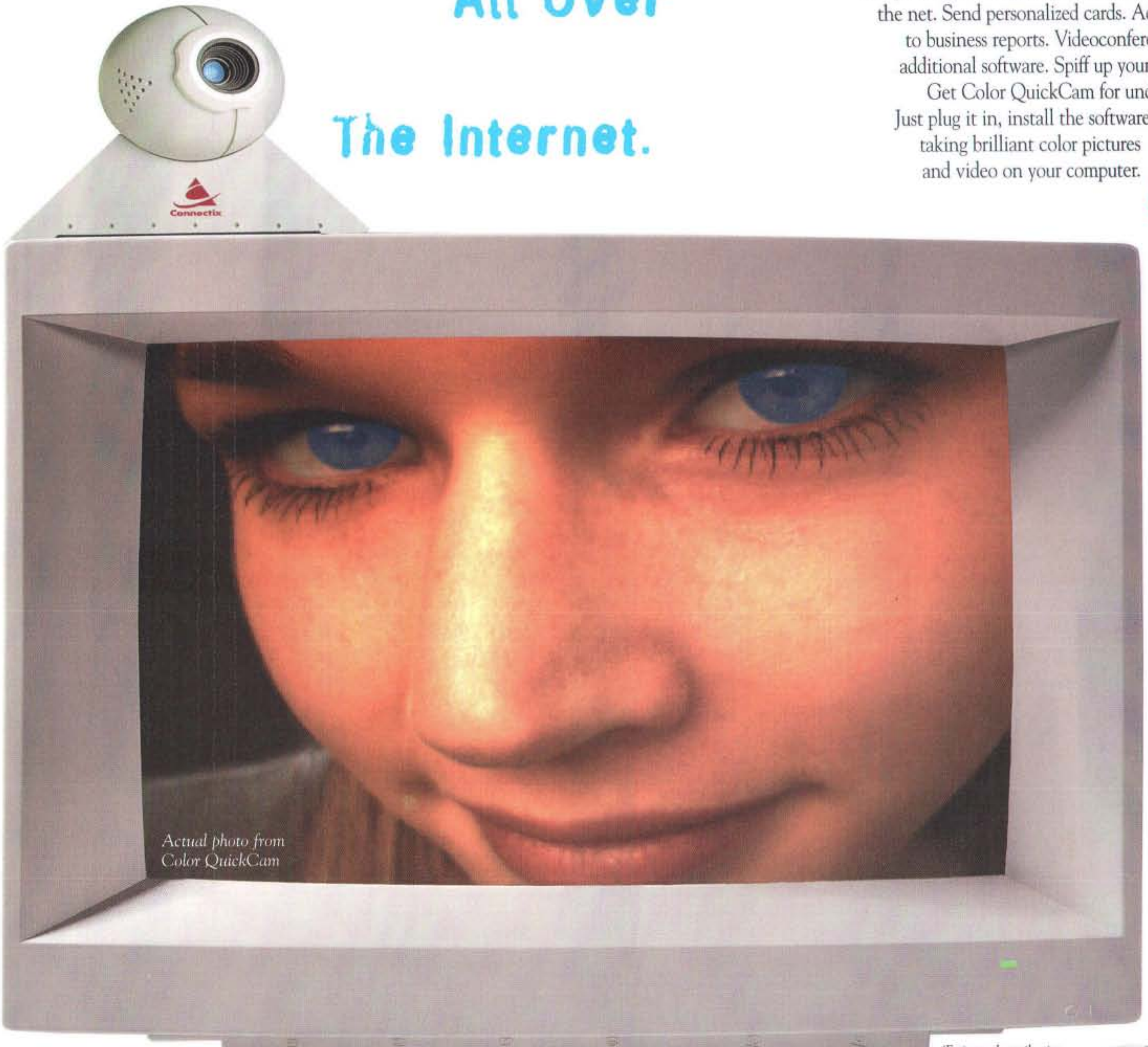

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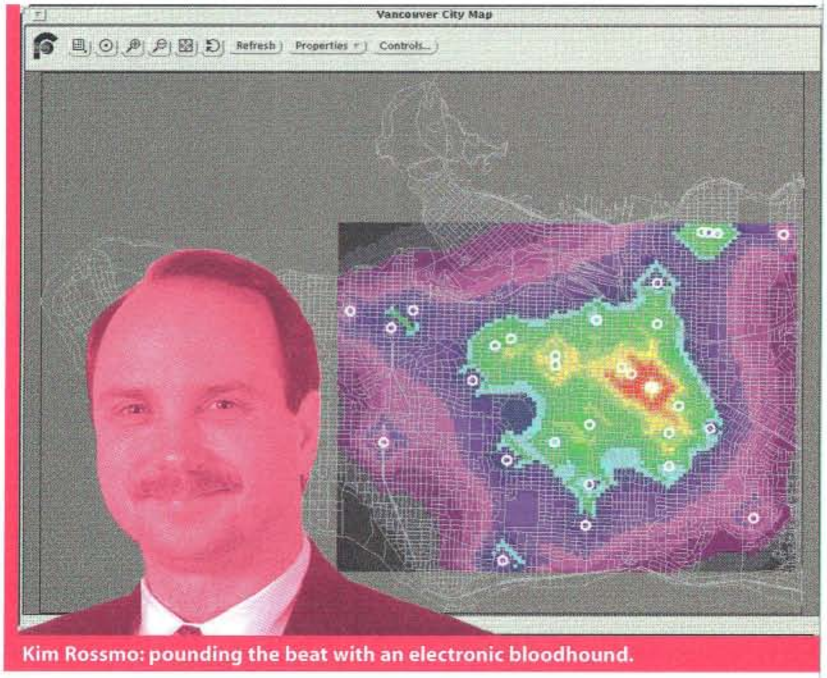
Serial Killer Application



Kim Rossmo: pounding the beat with an electronic bloodhound.

In the 1991 movie *The Silence of the Lambs*, a frustrated Jodie Foster tells an FBI colleague that if there had been a spatial pattern to serial killer Buffalo Bill's murders, the computer would have picked it up. Kim Rossmo remembers smiling as he watched that scene. He knew that no such computer program existed – but he was busy inventing it.

Five years later, in his office at Vancouver Police Headquarters, Rossmo unveiled the real thing: Orion, a software program for hunting serial criminals. "There are 79 crimes on this screen," says the detective-inspector, pointing to a Sun Microsystems UltraSPARC that displays a map of the Vancouver area. Rossmo is using the career of the Paper Bag Rapist – a notorious criminal who wore masks when assaulting victims – to demonstrate how Orion can help detectives figure out where serial criminals live, often within a few hundred yards.

At first glance, the crime sites on the screen look like a random collection of dots scattered all over the map. As the program goes to work, however, a pattern emerges. "The computer performs 790,000 different calculations," says Rossmo, who began developing the program in the early 1990s while earning a doctorate in criminology and working night shifts on the skid row beat. Using data on the typical distance traveled to commit a crime, the computer calculates the probability of any given point on the map being the offender's home – and then repeats the process for all the other points on the map and every crime site. "It produces a map that expresses the probability of offender residence," Rossmo says. With a couple of keystrokes, he calls up a street plan with a red dot over a single square block – an area that includes the apartment in which the Paper Bag Rapist was apprehended.

Orion can help pinpoint where criminals live – often within a few hundred yards.

Orion is being tested in serial arson, murder, rape, and other investigations, often with spectacular results. In one case, the program pinpointed the work site of a man who was robbing credit unions during his lunch break. In Ontario, Canada, Orion picked out a sex killer's neighborhood from an area of hundreds of square miles, reducing a database of 3,200 names to a handful of likely suspects.

Rossmo has created a private company to develop and market the Orion system. In the meantime, he's been asked to demonstrate how Orion can crack unsolved cases in the files of Scotland Yard, the Royal Canadian Mounted Police, and the FBI Behavioral Science Unit – the inspiration for *The Silence of the Lambs*. – *Taras Grescoe*

Reclaiming the Desktop

Flat-panel technology is poised to invade the desktop. Toshiba, Sharp, and NEC Corporation have increased manufacturing capacity, making flat-panel LCD screens more abundant – and less expensive. With LCD prices dropping between 10 and 15 percent in the last year, a window of opportunity has opened to exploit the weakest feature of traditional desktop cathode ray tubes – their ungainly bulk.

Although first-generation consumer desktop LCDs – like Portrait Displays' US$1,500 PageMaster – use passive matrix screens, prices will continue to drop for higher-quality active matrix screens. "By 2000, we anticipate that the vast majority of screens will be active," says George Aboud of Stanford Resources Inc. – *Julie Sullivan*

Less is more.

Of all the companies that make speakerphone modems, only Global Village considers how somebody would actually use one. So we added a simple button to answer calls when your computer is off or (#@*!!) down. No other speakerphone modem lets you do this. Other common sense additions include Global Village's Focal Point™, the only software that integrates fax,

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Tabla Tronic

Raised in England, musician Talvin Singh traveled to India as a teenager to learn to play tabla drums. On returning to the UK, he found himself drowned out by Western musicians. "I felt like a novelty, like some incense burning in the corner," he recalls.

The experience prompted him to develop an internal microphone and digital processing system for his percussion instrument. This synthesis of traditional Indian music with the technology of experimental electronica is what he calls *cyber tablas* or *tabla tronic.*

Singh has performed with artists like Björk and Massive Attack, but he maintains a fierce independent streak. His label, Omni Records, was created to spread an international sound that combines the past and future in the present. The goal, he says, is to integrate new media with "a certain type of aesthetic, which isn't really about samplers or cut-up music. It's about composing new music." – *Amitav Koul*

Talvin Singh: International synthesis.

The Mystery of Chick Comics

You've seen them fluttering from phone booths, wedged into bus seats, or hidden between condiment bottles at your neighborhood restaurant: undersized religious comic books with provocative titles like *This Was Your Life*, *Creator or Liar?*, and the ominous *Room 310*. The 24-page, pocket-sized pamphlets are a fixture of modern life – tiny, evangelical cries rising from the cacophony of the urban landscape.

Revelation: coming soon to a phone booth near you.

Yet once you've picked one up, you can't seem to put it down – a fact that Chick Publications, the self-supporting ministry and printer of the leaflets, counts on. With 390 million booklets sold in more than 60 languages and a catalog of 70-plus titles, Chick knows that not even amateurish cartoons, implausible plots, or a dark, apocalyptic tone will deter headstrong atheists from reading its comics.

Jack Chick's tracts deliver the gospel with all the gentleness of a jackhammer.

Last year, Chick took its wares to the Net at *www.chick.com*, with an online site proffering sample tracts, catalogs, and a predictable dose of born-again proselytizing. The company's homepage offers a biography of founder Jack T. Chick, "Eight Reasons Why Chick Tracts Get Read," and a list of other products sold, including the popular Evolution Poster, which illustrates "how ridiculous the theory is."

Though the site draws its share of traffic, the company's ecumenical philosophy isn't without detractors. Several Christian netizens have taken umbrage with the company's doomsaying, all-or-nothing spiritual approach. Critics also point out that some Chick comics are blatantly antigay, anti-Catholic, anti-Semitic, or inherently racist. Each delivers the Christian gospel with all the gentleness of a jackhammer.

Getting a statement from the big man himself proves next to impossible. "Mr. Chick doesn't really have time for interviews," explains sweet-as-pie Amy, who runs the Chick Web page from Chick headquarters in Chino, California. Amy says she'll need to check with her supervisor before answering any further questions. It's the last time I hear from her. Like email and the Lord, Chick Publications works in mysterious ways. – *Colin Berry*

Jargon Watch

Brilliant Weapons Military jargon for the next generation of weapons systems that go beyond "smart," such as those that use nanotechnology.

Chaord A self-organizing, adaptive, nonlinear, complex system (whether physical, biological, or social) that simultaneously exhibits characteristics of order and chaos. A system that exists between rigidity and flexibility.

Blamestorming To sit around and discuss why a deadline was missed or a project failed and who's responsible. Like brainstorming, from which it is derived, blamestorming is done with little regard for the quality of contributions to the discussion.

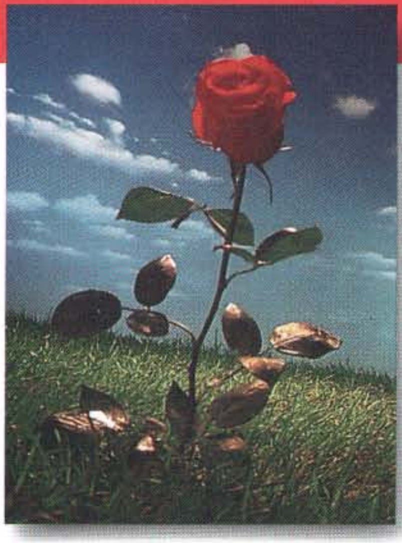
Geeksploitation The act of taking advantage of twentysomething digital workers who are flushed with pioneer enthusiasm and willing to work very long hours if bolstered by junk food, flexible work schedules, and no dress code.

Stalkerazzi Paparazzi who will go to any length to get the celebrity shot they desire.

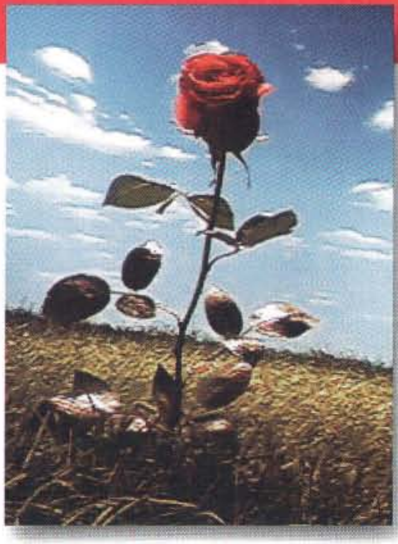
Tip o' the felt fedora to Mikki Halpin, Peter A. Ndenga, and Bruce Sterling.

– *Gareth Branwyn* (jargon@wired.com)

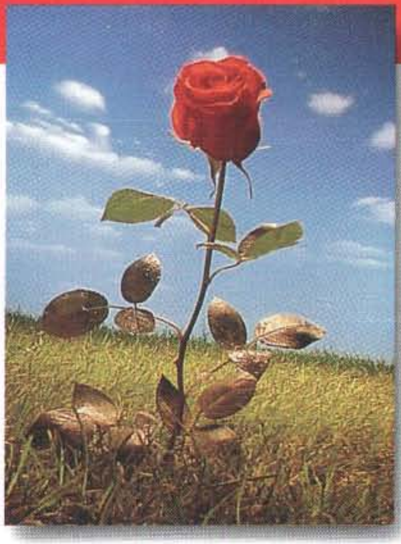
A rose is a rose is a... wait a second.



Kodak DC-40 Digital Camera



Casio QV30 Digital Camera



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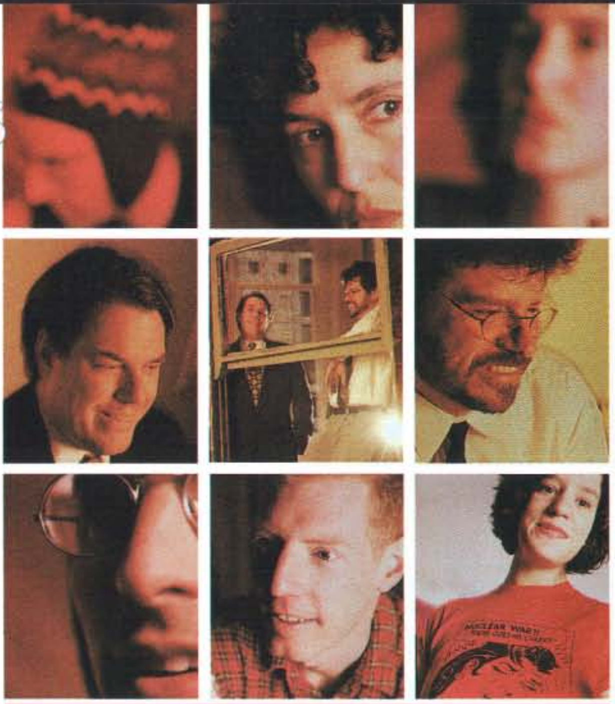
Theater Geeks



Head shots: techie creatives at Avelino Associates.

Michael Palladino likes to tell the story about the time he and several of his employees at Avelino Associates were getting ready for a major presentation to a potential new client. They scrambled and gambled and got everything together. After one last deep breath, they walked into the conference room, ready to deal. The client took one look at the polished professionals and quipped, "What'd you do, hire a bunch of actors?" The Avelino gang exhaled, sputtering and laughing. The cover had been blown.

In fact, the Avelino-ites *are* a bunch of actors. And directors and writer-performers. Palladino prefers to hire theater artists for Avelino, a San Francisco-based organizational development and systems integration firm. More than half of the company's 20 employees are arts professionals, and Palladino knows that their creativity and organizational skills are highly developed – and highly transferable.

"Art and business are not separate things," Palladino says. "We've combined them."

Avelino aspires to create a working synergy that brings together professionals from technology and the arts – their work will flow from one arena to the other, cross-fertilizing both. "Art and business are not separate things," Palladino says. "We've combined them." Indeed, he has reshaped his workplace in keeping with a simple and potent vision. "Community is what's important. Business is simply how you pay for the important things in life, like art. It's not the point itself."

Avelino's predilection for mixing business and the arts goes beyond hiring artists and granting flex time for rehearsals. For the last several years, Avelino has allied itself with Z Space Studio, a collective of independent actors, directors, and playwrights. Palladino serves as president of Z Space's nonprofit board, while Z Space's artistic director, David Dower, occupies the vice president's slot at Avelino.

When Avelino expanded into new digs in December 1996, the renovation included two theater rehearsal spaces, a Z Space office, props storage, a library/writers' room, and a multimedia presentation area. Other arts groups and community organizations have been invited to use the facilities as well.

"Popular business books like to use theater as a metaphor," says Palladino. "But that's wrong. Theater isn't a metaphor, it's a model. How a play goes up on stage is exactly how a successful project can be put together. It's all about creativity and collaboration."

Of course, all that creativity can sometimes get a little silly. Eavesdrop on Dower, bandying about his plans for a new production: "I want to stage Hamlet holding a laptop instead of Yorick's skull." He holds out both hands, cradling an imaginary laptop: *Alas, poor Yorick! I knew him, Horatio: a fellow of infinite jest, of most excellent fancy.* – *Mary DeDanan*

Wired Top 10

Sites most frequently linked to via WebCrawler

Site	Number of links
1. Download Netscape Software	35,979
2. Yahoo	33,758
3. WebCrawler Searching	25,717
4. Welcome to Netscape	20,884
5. WebCounter Home Page	19,857
6. The Blue Ribbon Campaign for Online Free Speech	16,395
7. Starting Point	11,978
8. Microsoft Corporation	10,342
9. Lycos Inc. Home Page	9,875
10. Infoseek Guide	9,053

Based on data from 1,606,502 documents on more than 259,847 different servers, as of September 16, 1996.

Source: *webcrawler.com/WebCrawler/Top25.html*

– *Gareth Branwyn*

Postmaster, Pass By

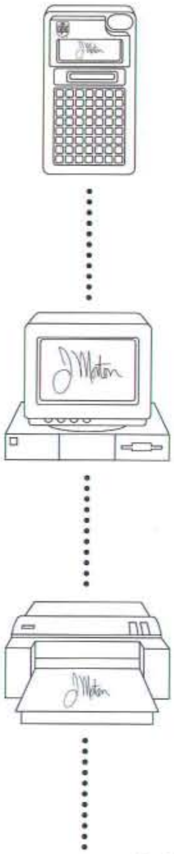
Wanna lose 41 pounds? Forget Weight Watchers – try calling the Stop Junk Mail Association. The SJMA says advertisers send the average adult 41 pounds of junk mail each year.

Consultant Michael Esh founded the Sausalito, California-based organization in 1991 after he returned from vacation to find so much junk pushed through his mail slot that he had problems opening the door. "Eventually, I put two and two together and got motivated," he recalls.

Esh turned his annoyance into a crusade more than 5,000 strong. "The data collection industry is insidious and huge, and it pulls data from every manageable and conceivable source," Esh says. "People must stay informed." – *Bill Brazell*

PHOTOS ABOVE: JOHN WESLEY LEMON;
PHOTO BELOW: JOHN NEUBAUER/FPG INTERNATIONAL

Forget the pudding. The proof is in the signature on your computer screen.



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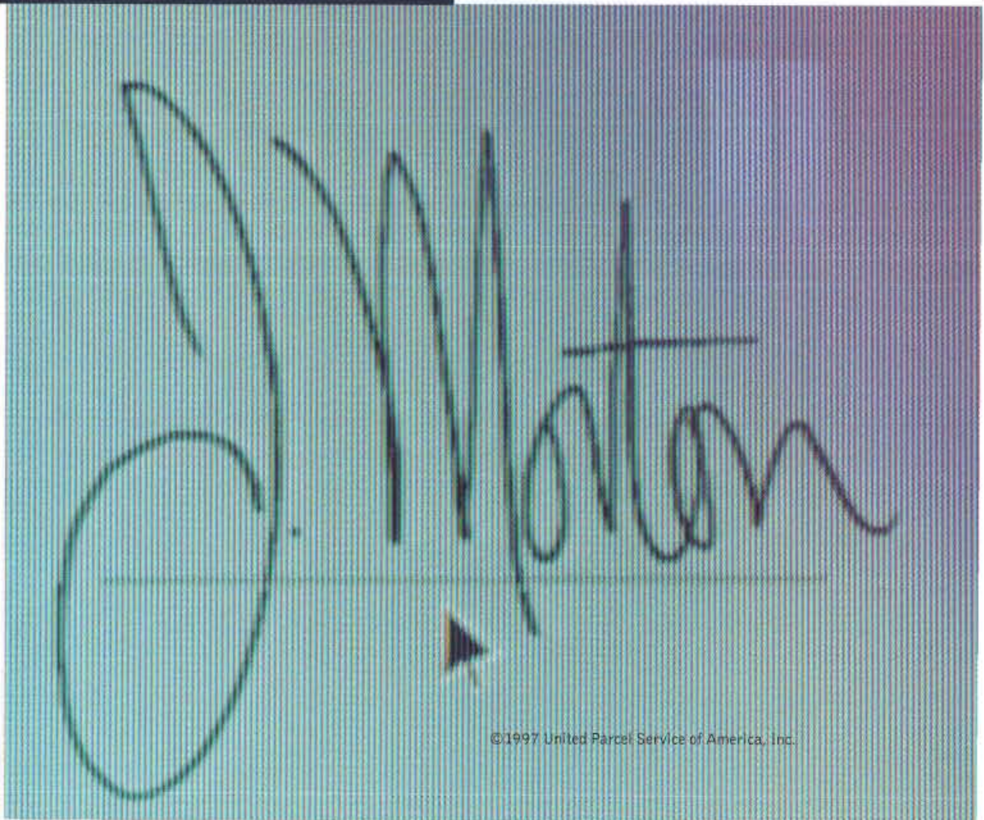

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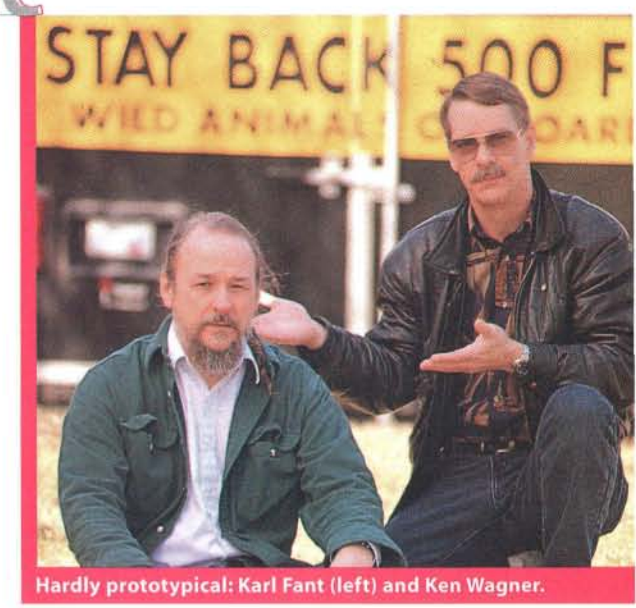
Unconventional Logic



Hardly prototypical: Karl Fant (left) and Ken Wagner.

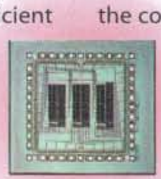
Karl Fant wants to get rid of clocks. They're too rigid, too expensive, and they take up too much space. The clocks in question reside within computer chips, governing the pace at which information is processed. Find a way to junk the clocks, and you can build faster, cheaper, smaller, and more efficient processor chips.

Scientists and engineers have struggled with the clock problem for decades. Fant thinks he's found an answer. His study of computer programs and biological systems led to a new theoretical model that serves as the foundation for Theseus Logic Inc., a Minnesota company that hopes to license his ideas to the world's chipmakers.

The insights helped Fant break the constraints of Boolean logic, which has served as the basis of computer design since computers began. Fant's Null Convention Logic doesn't require the synchronizing clocks of Boolean systems. Instead, NCL-based circuits communicate with one another as soon as information is ready for processing, regardless of artificial timing issues. The result, he says, is a chip that is roughly 50 percent cheaper to design and 40 percent less power hungry than today's average circuit.

Find a way to junk clocks, and you can build faster, cheaper, and more efficient chips.

Theseus unveiled Null Convention Logic in August 1996, and to date, the company has produced seven working prototype chips. Little has been published about the designs, but Fant and Theseus president Ken Wagner pulled off a US$1.9 million private stock offering in 1996 and have plans for another offering in 1997. Development efforts are supported by a $2.3 million DARPA contract, and the company has also launched an alliance with a Lockheed Martin subsidiary to test the chip in the F-22 fighter plane test bed.

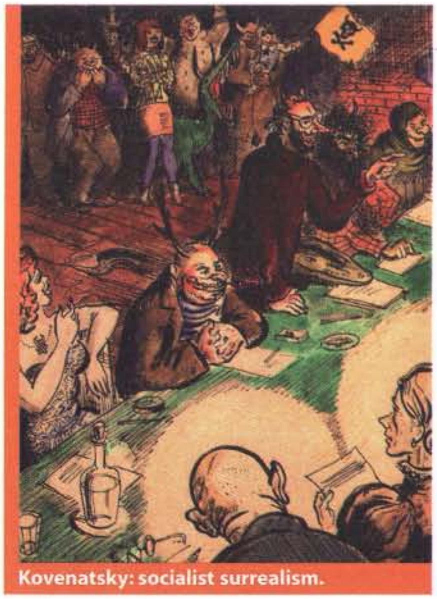


Linley Gwenapp, editor in chief of *Microprocessor Report*, points out that "there are a hundred ways a technology can fail despite working prototypes." He's right, but that hasn't turned off execs from Intel and Motorola, who are watching Theseus closely to see if the company's chip can solve some of the problems big manufacturers face as they struggle to engineer faster and more complex chips into ever shrinking spaces.

While touting its chip's ability to run at different speeds (depending on processing needs) and the ease with which engineers can connect independently designed chips, Theseus is aiming high. "Our business paradigm is to become the Dolby Sound Systems of computing," Wagner boasts. "We will live to see the world operating on Null Convention Logic." – *Tim Broeker*

PHOTO ABOVE: JAMEY GUY

Post-Soviet Resurrection



Kovenatsky: socialist surrealism.

Vladimir Kovenatsky never escaped Soviet Russia before he died in 1986, but now the illustrator's underground works have surfaced in New York.

A child prodigy, Kovenatsky received a prestigious commission to design *The Collected Works of Jack London* at age 19. Considered schizophrenic by some, he developed his visual skills by illustrating books, magazines, and filmstrips, but his secret passion was drawing cartoons. Displaying a cast of aliens, giants, and passed-out drunks, Kovenatsky's subversive drawings poked fun at the daily routine in the USSR.

Kovenatsky is being hailed as a pioneer for modern cartoonists. "The work insists on free mental space and puts him in kinship with what was happening with artists here in the '60s," says Pulitzer Prize winner Art Spiegelman.

Kovenatsky's work includes a picture book of childhood caricatures, a full-length autobiography, and hundreds of drawings. Check out a sample at *www.moscowchannel.com/*. – *Julie Sullivan*

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Saturn is part of the curriculum in Professor David Aaker's class at UC Berkeley. (Go Bears!)

It seems that besides coupes, wagons and sedans, we also make one heck of a final exam.

We've heard of many instances where Saturns have been given as graduation gifts. (Most of us here remember getting pen and pencil sets.) In that case, we suspect this year's graduating class will be quite impressed with the newly redesigned Saturn coupe.

Apparently, a Saturn showroom isn't the only place you can go to learn more about Saturn. All across the country, some pretty prestigious universities are offering us up as a case study in everything from organizational theory to marketing to global logistics. Not only that, we're on the recommended reading list of a few sociology departments, as well. This is pretty heady stuff, especially when you consider we didn't even exist as a company until a few years ago. And now to be held up as a role model for future MBAs to study, why, it's quite an honor. It's also a very good example of what happens when you do your homework.

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The Future of Bionics

You've heard the hype.
We asked the experts.
Here's the *real* timetable.

In 1974, we learned that Colonel Steve Austin, an astronaut whose arm, legs, and eye had been destroyed in an accident, could be rebuilt. "We have the technology. We have the capability to make the world's first bionic man," Oscar Goldman said on *The Six Million Dollar Man* TV series. More than 20 years later, Austin would wear a US$17 million price tag, which probably explains why he thrives only in reruns. But thanks to neuroscience research and the miracle of microelectronics, astounding breakthroughs in prosthetics are on the horizon. *Wired* asked four experts about the future of bionics. Unfortunately, Lee Majors was not available for comment.

	Artificial Vision	Bionic Limbs	Hi-Fi Cochlear Implants	Bionic Person
Durfee	**2040**	**2020**	**2030**	**unlikely**
Humphrey	**2020**	**2005**	**now**	**2050**
Jenkins	**unlikely**	**2016**	**now**	**unlikely**
Loeb	**2050**	**2010**	**1998**	**unlikely**
Bottom Line	**2040**	**2013**	**2005**	**unlikely**

William Durfee
PhD, associate professor of mechanical engineering, University of Minnesota

Donald R. Humphrey
PhD, professor of physiology and neurology, associate dean for research, Emory University School of Medicine

William M. Jenkins
PhD, vice president for development at Scientific Learning Principles Corporation

Gerald E. Loeb
MD, professor and director of the Bio-Medical Engineering Unit at Queens University and chief scientist at Advanced Bionics Corp.

Recent experiments involving direct electrical stimulation of the brain have enabled blind people to "see" simple light patterns, but our experts agree that researchers have a long way to go before technology can provide near-normal sight to the blind. Jenkins thinks that jacking into the visual cortex may eventually enable "letter recognition or limited form identification," but even that is probably 20 years away. Humphrey notes that the cerebral cortex is extremely complex; leads to the brain from a videocamera would have to be perfectly placed to yield useful results. Even if this level of precision is achieved, he believes, technological limitations would prevent the image from having useful color: "The details would be crude – like a neon sign – and motion would not be reproduced faithfully."

Since the 1970s, companies have developed "myoelectric" limbs that are actuated by electrical signals transmitted from underlying muscles to the surface of the skin. The next step is to interface motor nerves with sensors in the artificial limb – enabling a prosthetic to respond to brain signals. Humphrey says that his laboratory has controlled a robotic wrist using cerebral recordings of a monkey moving its wrist. What's preventing this technology from entering into clinical trials? "Small movements of the recording electrodes in the cerebral cortex damage the tissue, weakening the signal over time," Humphrey says. Even if that and other problems are solved, Loeb adds, "only a small number of patients with high, bilateral amputations are seriously enough handicapped after being fitted with existing prosthetic technology" to justify the expense and invasiveness of neural interfaces.

According to the experts we spoke to, cochlear implants – electrodes implanted in the cochlea to stimulate auditory nerves – are the most successful bionic prosthetic to date. In fact, a high percentage of patients report that implants already provide fidelity close to that of normal ears – enabling them to talk comfortably on the phone, for example. "They hear very well: they enjoy their recovered communication skills and the ability to recognize the various environmental sounds that we all take for granted," Jenkins says. In agreement, Durfee comments, "It's not clear if the market is ready to go beyond what is required for 'functional hearing.'" Whether that's true or not, "We have a way to go before the complex nuances of a Mozart concerto can be appreciated," Humphrey says.

Advanced bionic components may be within our grasp, but putting them all together in a real-life superpowered Steve Austin will probably remain the stuff of sci-fi. While a bionic person may be theoretically feasible, Humphrey says, "the major problem lies in overcoming tissue-material interfaces." And that's a biggie. Not only do artificial tendons and ligaments have to be connected to real ones, artificial muscles don't yet approach the size and power of human tissues. Our understanding of motor skills and the brain's sensory and perceptual abilities has really just begun. "Continued research in neuroscience and bioengineering will no doubt lead to improvements in man-machine interfaces and functional replacements," Jenkins says, "but it will be a long, hard road filled with many failures and a few successes."

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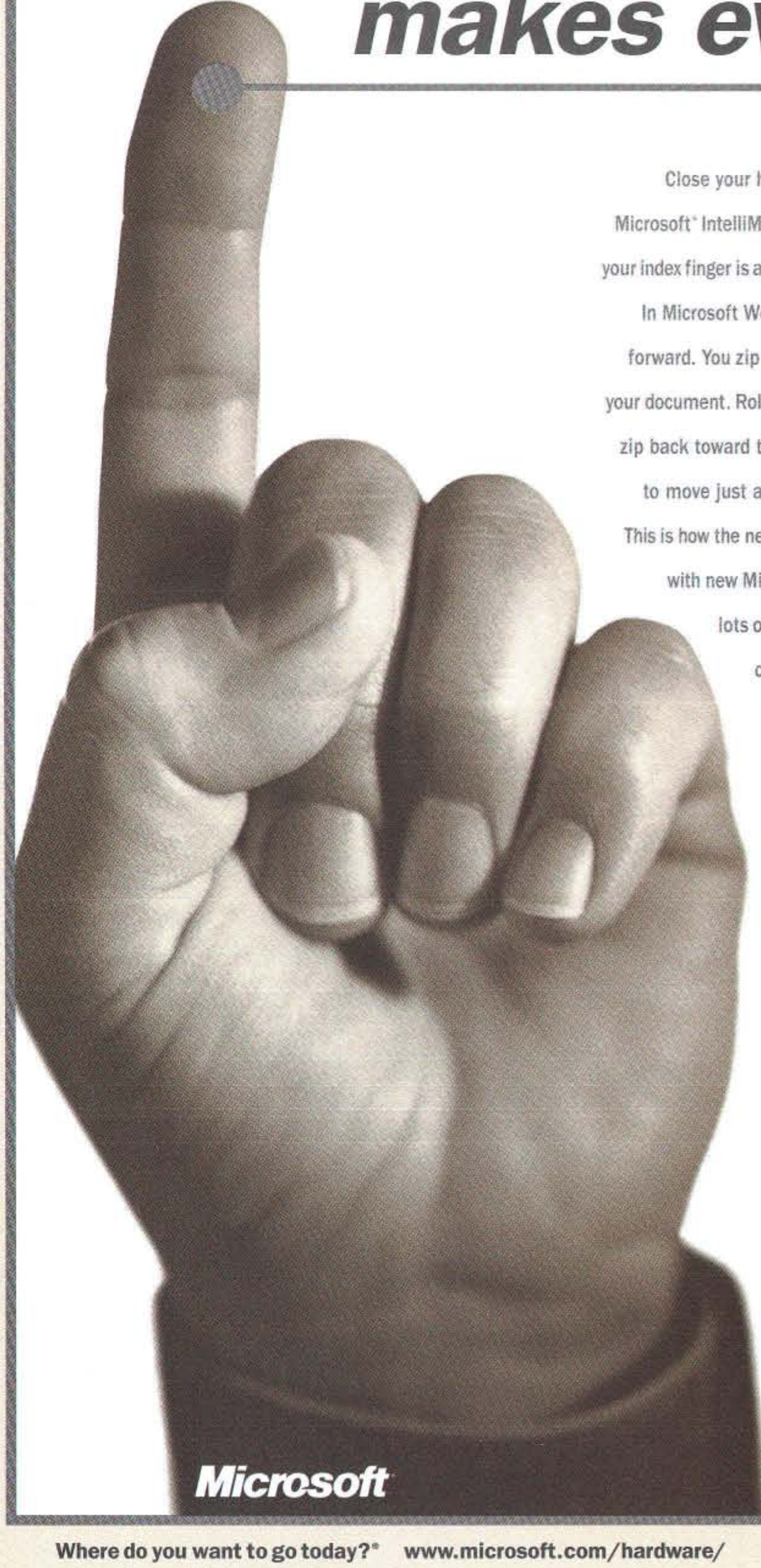

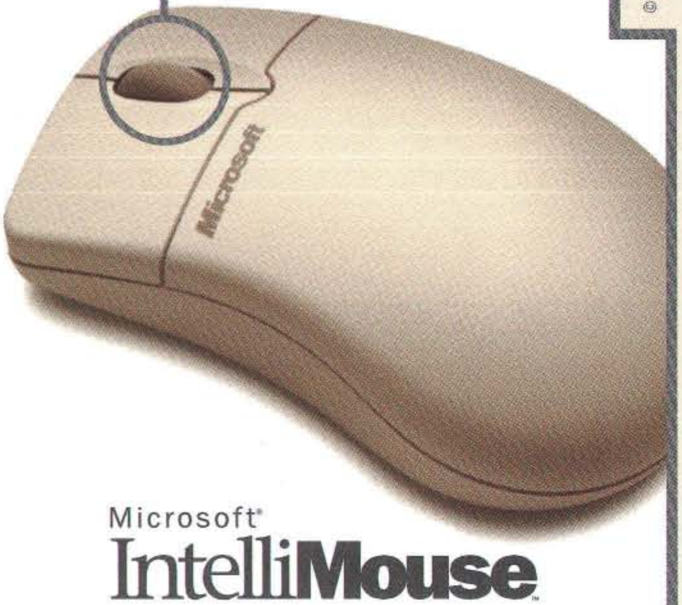

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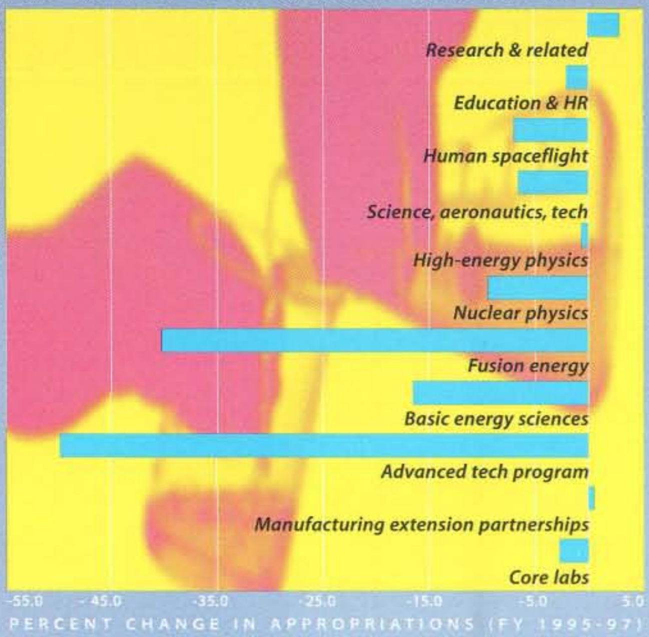
Funding Science

The 104th Congress is gone, and what legacy did it leave for science? Not a good one. Between fiscal years 1995 and 1997, there was a negative change for most science programs, including NASA and the Department of Energy. It's likely that pressure to balance the budget is to blame. Then again, Congress may just hate science.

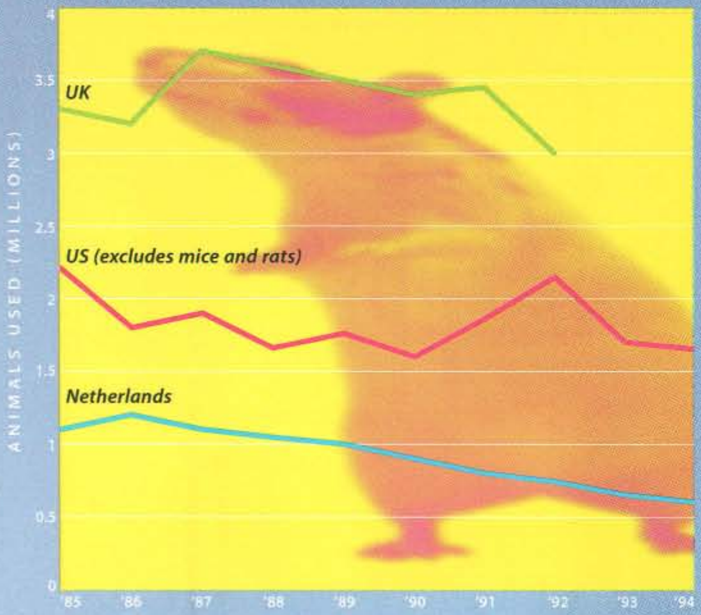
SOURCE: AMERICAN INSTITUTE OF PHYSICS, BULLETIN OF SCIENCE POLICY NEWS



Animal Testing

Finding alternatives to animal testing is becoming a growth industry. Concerns about expense, changing attitudes, and activist pressures are helping bring new methods, like in-vitro tests, to market. And while the number of animals used for testing has dropped, some scientists caution that there is often no substitute for measuring the response of a living organism.

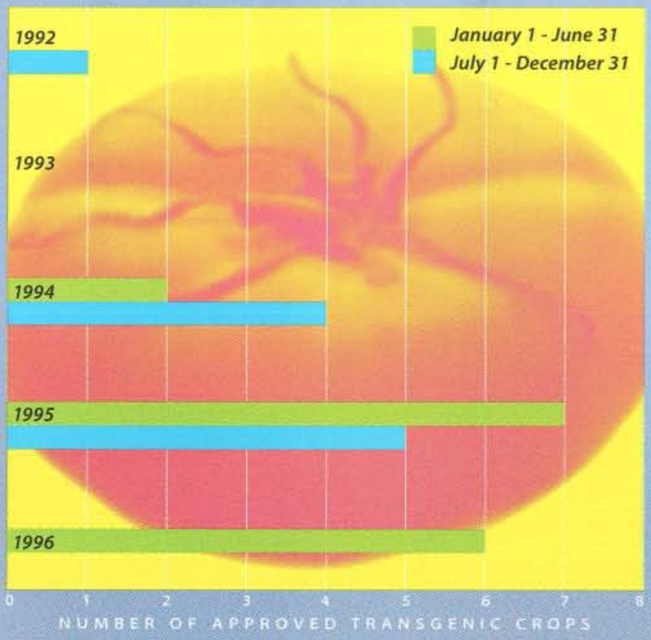
SOURCE: *SCIENCE*



Transgenic Crops

While public concern over genetically engineered crops has subsided in the US, some researchers are pointing out another problem: the advantageous genes of these crops could escape into the ecosystem and create a hardy new race of weeds. Luckily, many transgenes, like those that make tomatoes ripen more slowly, would hold little benefit for wild plants.

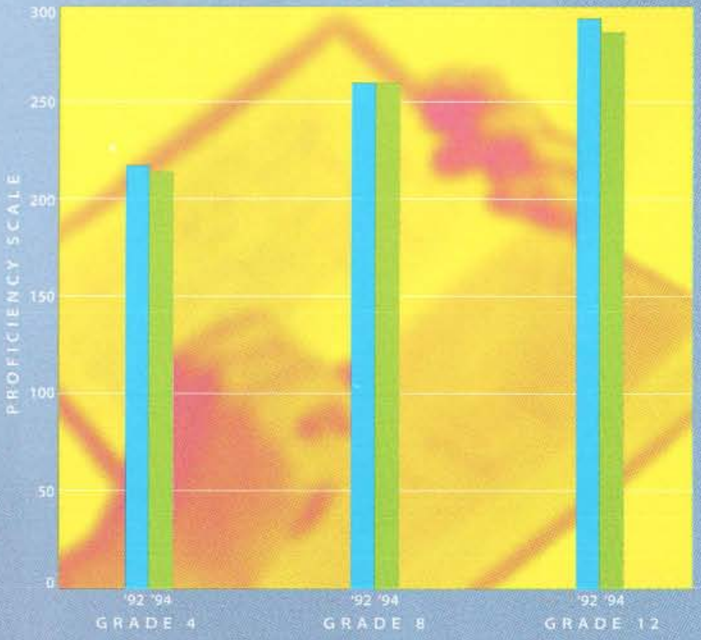
SOURCE: USDA, ANIMAL AND PLANT HEALTH INSPECTION SERVICE

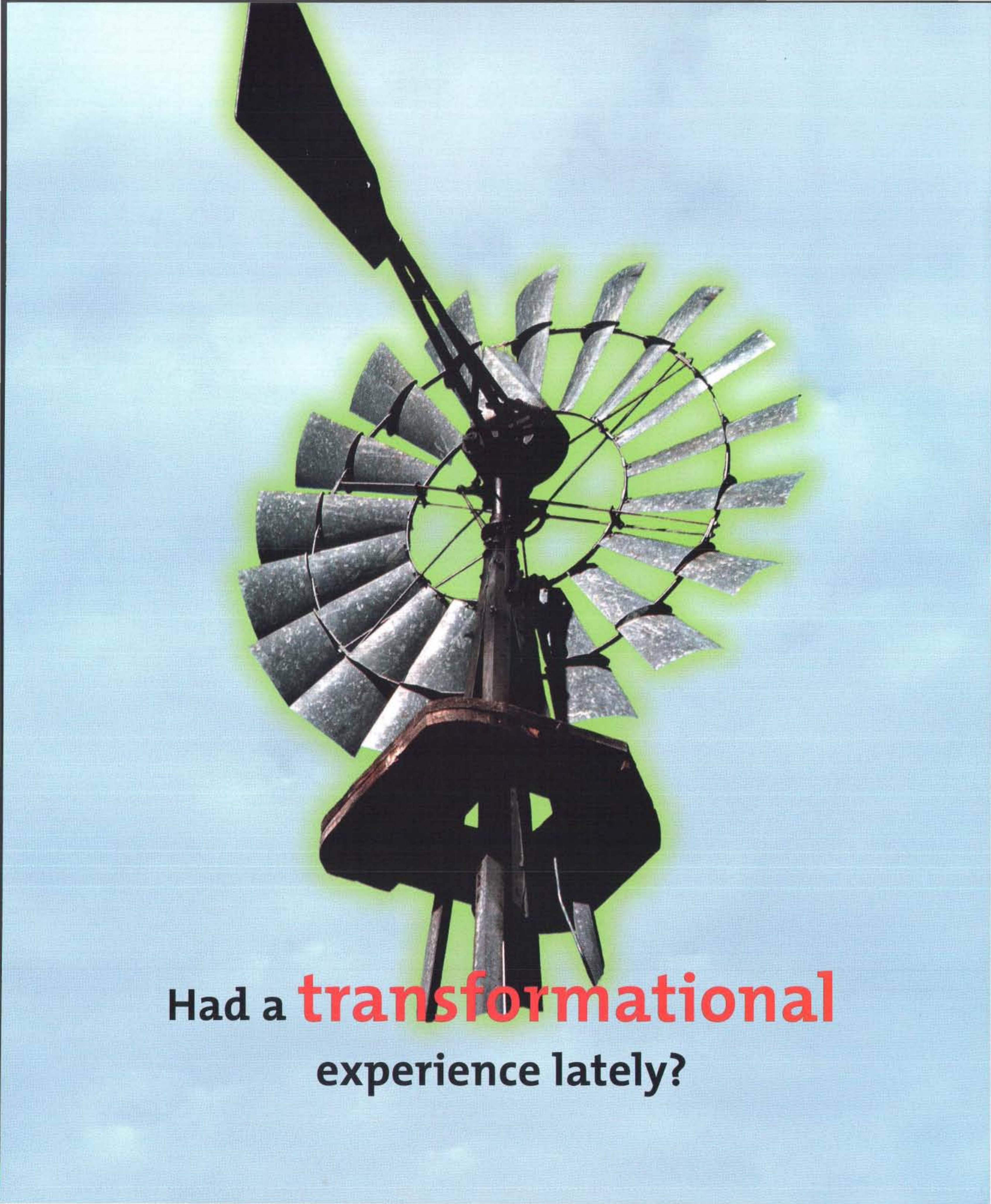


Reading Is Fundamental

The National Assessment of Educational Progress reported a decline in 12th graders' reading proficiency that was evident in lower-performing students in all assessed reading purposes: literary experience, gaining information, and performing a task. Though high school may be the last academic hurdle for many, students shouldn't be lost so near the end of the race.

SOURCE: NATIONAL CENTER FOR EDUCATION STATISTICS





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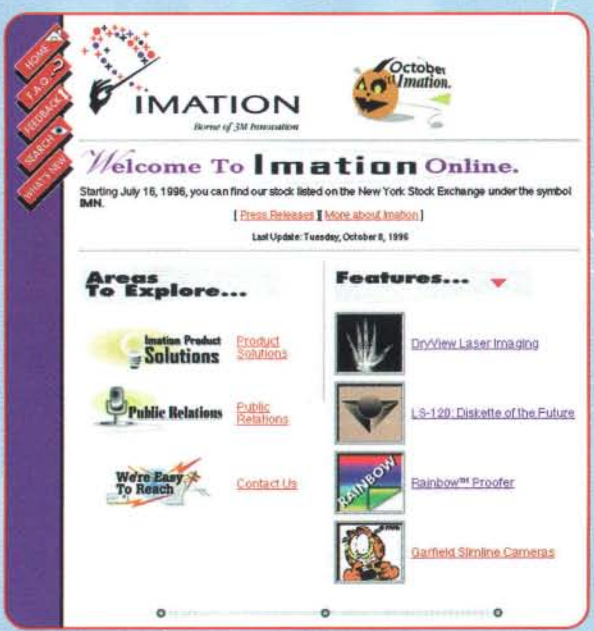

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Last Update: Tuesday, October 8, 1996

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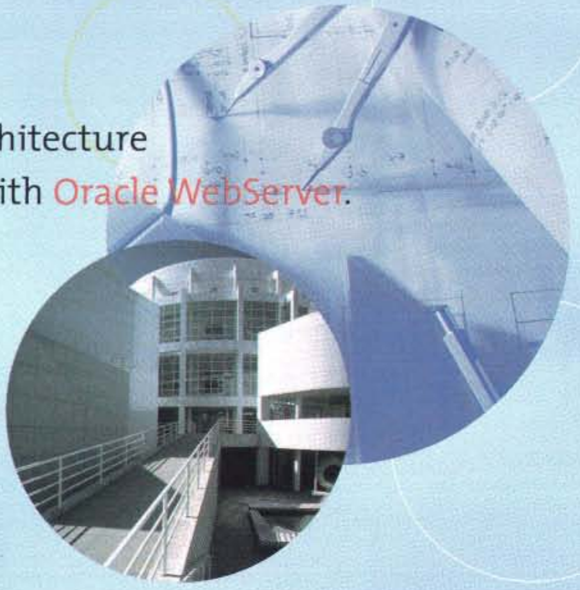

The University of Melbourne Department of Architecture designs a brilliant new curriculum with Oracle WebServer.

The University of Melbourne's intranet gives architecture students access to images and lectures on everything from the Sydney Harbor Opera House to designs by Frank Lloyd Wright.

Students at the University of Melbourne's Department of Architecture are building presentations directly on their intranet, thanks to Oracle WebServer. Now they have access to everything from the specifications of the Sydney Harbor Opera House to the designs of Frank Lloyd Wright.

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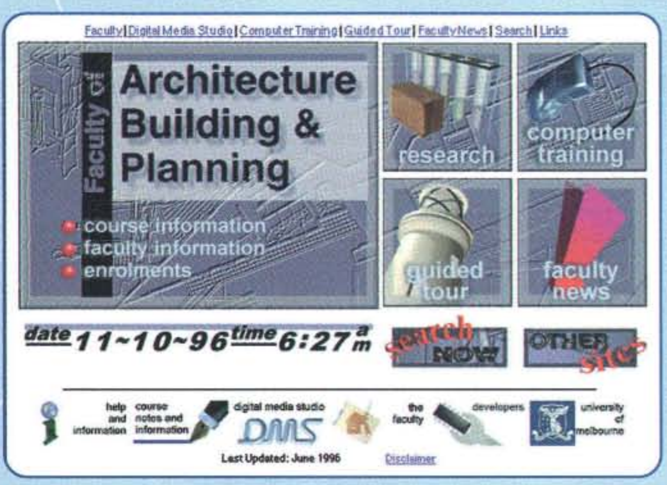

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IT'S NOT A TOY.

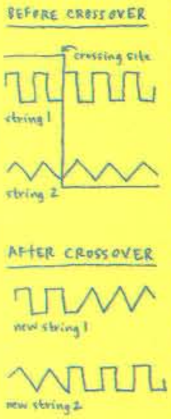
Mother Nature on a Motherboard

Genetic algorithms help planes fly and buses run.

By Jessie Scanlon

John Holland, the father of genetic algorithms, laid out the basic theory of GAs in the early 1970s. The underlying principle was that the powerful creative forces of evolution – the laws of natural selection and genetics – could be applied to complex computational problems.

As the name implies, a genetic algorithm is a formula or solution based on the core tenets of genetics: reproduction, crossover, and mutation. Take the problem of designing the most efficient airplane wing. A team of aerodynamics engineers could spend months designing a wing, crunching numbers about airflow, lift, and stress before finding a solution. A genetic algorithm would define a wing as a string of variables (such as size, shape, weight), create hundreds or thousands of sample wings, test the individual members of this wing "population" to determine how well they measure up to the desired performance, and let the fittest – the most aerodynamic – survive.



The beauty of GAs lies in their robustness, their ability to solve a wide range of problems (including machine learning), and their knack for engineering optimization, in which a problem's most efficient solution must be found. Another advantage is GAs' ability to evaluate multiple solutions simultaneously. This implicit parallelism not only makes GAs faster than traditional algorithms – GAs can solve problems in subquadratic times – it also lends itself to parallel computing.

To understand the core technology, consider a very simple optimization problem. Imagine a black box with five on/off switches that control the box's output – voltage. We want to find the combination of settings that produces the greatest electrical charge. The first step is to develop a "coding scheme" – a numeric representation of the problem. In our example, each possible solution will be expressed by a five-bit binary string in which on is represented by a 1 and off by a 0. We must also define the parameters of the problem: population size, crossover and mutation rates, and the number of generations. There are no standards – populations could range from 50 to 640,000 strings depending on the problem's complexity, and the rate of genetic operations will vary by user. The next, most critical step is to write a fitness function that calculates the fitness of each member of the population. In the box example, solutions generating a higher voltage earn a higher score.

Once the fitness function has been written, we need to create an initial population of organisms, or strings of bits, by picking a set of random strings. The initial population should be large (and diverse) enough to ensure healthy evolution. Too small a population will lead to the GA equivalent of inbreeding.

Reproduction – the first GA operator – essentially copies members of the initial generation and passes them on to the second. Strings with higher fitness scores have a *proportionally* greater chance of contributing offspring to the next generation, but even the fittest is not guaranteed to survive. This probabilistic reproduction reflects the randomness of biological reproduction – meeting Mr. Right is largely a matter of chance, after all.

Individual strings of the new generation are then paired or "mated" based on fitness, and crossover takes place. This technique mimics biological sexual recombination: each parent contributes a portion of DNA to the offspring. For example, the first three bits of string A (11011) are swapped with the corresponding three bits of string B (10110), thereby creating two new strings – 11010 and 10111. The crossover specifics vary from the simple one-point swap illustrated above to a process involving multiple cut points, but in all GAs this is the workhorse operation, forming up to 90 percent of the next generation.

In the final genetic operation – mutation – one bit is flipped or reversed. The importance of mutation to evolutionary progress is hotly debated: Stanford University computer scientist John Koza once described mutation as "a sideshow," while David Goldberg, a GA researcher who worked with John Holland, thinks of it as an "insurance policy": mutation restores bits lost through reproduction and crossover. At most, however, the computer might insert a random bit change into 3 percent of the population.

Once the new generation's fitness has been calculated, the three-step process repeats for a set number of generations or until a specified fitness level has been achieved. The simple box problem would be solved within several generations, but the GA will really shine in a more complex problem with hundreds of variables.

So why are genetic algorithms the bastard children of computer science? Why were they rejected by most scientists? "Many of the accusations leveled against the early GAs were accurate," admits Goldberg. "People were fixed on a particular way of doing crossover and mutation that turned out to be very brittle with more difficult problems." In other words, populations tended to converge before an optimal solution was reached, and once a population has lost its diversity, successive improvement in generations slows drastically. But just as modern genetics has moved far beyond Gregor Mendel's pea-pod observations, GA theory has evolved far beyond John Holland.

The best improvements in GA design hinge on what Holland called schemata – highly fit combinations of bits within the strings. "Identifying and propagating these building blocks as a unit, a supergene, is a key issue now," says Goldberg. Researchers have also refined GA design with alternate operators – such as adaptive mutation, dominance, and diploidy – and developed a better understanding of how the traditional operators interact. "We are learning how to design around the limitations of simple GAs," says Goldberg, "and we are crossing the threshold from being a weird science to being accepted."

GAs are also crossing into commercial applications. General Electric developed a hybrid system for jet engine design that combined GA technology with an expert system. And in Japan, Hitachi has developed a GA-based system to create efficient bus schedules. More experimental projects are using GAs to generate art and breed avatars. The fittest of these will survive. ■ ■ ■

Jessie Scanlon (jessie@wired.com) *is a section editor at* Wired.

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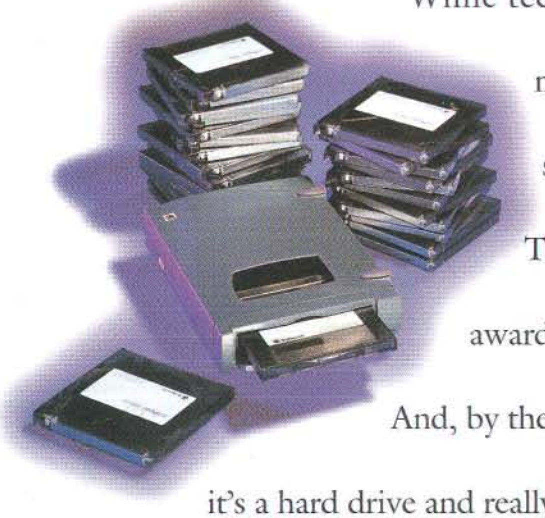

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Windows Winners

By Michael Murphy

Windows NT is driving a substantial upgrade cycle in the US. Sales of 486s – which can't run 32-bit software – are sagging, while Pentium sales are up. Because the necessary upgrades require more memory, faster modems, more complex software, et cetera, the whole electronics industry benefits. That cycle will spread around the world this year as Europe recovers from a near-recession and the Far East continues its double-digit growth.

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Company	Primary Business	Symbol	Shares	Close Dec 2	Δ Since Nov 1	Action
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The Walt Disney Company	Entertainment	DIS	1,500	73 7/8	+ 8 3/8	hold
Apple Computer Company	Hw/sw	AAPL	4,800	25 1/8	+ 7/8	hold
Tele-Communications Inc.	Cable television	TCOMA	4,800	14	+ 1	hold
Intel Corporation	Microchips	INTC	3,000	127 1/8	+ 18 3/8	hold
Adobe Systems Inc.	Software	ADBE	5,000	43 3/8	+ 9 1/8	hold
Mattson Technology	Semiconductor equip.	MTSN	30,000	9 7/8	+ 1 1/8	hold
Euphonix Inc.	Audio sw	EUPH	17,000	4 1/2	– 1/8	hold
Diamond Multimedia	Multimedia hw	DIMD	7,000	14 3/4	– 3 1/4	hold
Seagate Technology Inc.	Disk drives	SEG	300	40 3/4	– 24 5/8	hold
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Legend: This fund started with US$1 million on December 1, 1994. We are trading on a monthly basis, so profits and losses will be reflected monthly, with profits reinvested in the fund or in new stocks.

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At the same time, communications spending should continue to grow in excess of 30 percent a year. And because US companies dominate the world market, they are less susceptible to domestic recessions. Where are the winners? Everywhere.

Fab future

Look at semiconductor equipment manufacturers. These companies' stock prices could rise as much as 50 percent this year. More than 120 chip fabrication facilities are scheduled to be built over the next three years, several at a cost of US$1 billion or more.

Wall Street predicts domestic shipments will be sharply down this year. But the Street is wrong. While previous industry downturns were caused by recessions, demand for end-user products was up across the board last year. With the huge demand for silicon and the technology change to 0.25 micron lines under way, chipmakers can't hold off on increasing capacity. I expect pull-ins beginning in the March quarter, leading to a slightly up 1997 and a booming 1998.

In this stock sector, I recommend Applied Materials – the largest supplier with the broadest product line – as a core holding. Then I would buy smaller, specialty companies with advanced processes: Mattson Technology for rapid thermal processing and chemical vapor deposition, Plasma & Materials for etching technology, OnTrak Systems for wafer cleaning, Genus for high-energy ion implantation, and Credence Systems for chip testing.

For the chipmakers themselves, stock prices could rise 35 percent. Intel continues to drive the price/performance curve in the microprocessor business, leaving competitors to pedal faster or fall by the wayside. Intel stock should earn $7 a share in 1997 and sell for about 20 times that – $140.

Life for fabless chip companies – those that contract out for production of their chip designs – is easy because they can find sufficient capacity. I'm buying Cirrus Logic, a producer of graphics accelerators, disk-drive controllers, and audio and other PC chips. Cirrus is a major supplier to Intel, and its MiCRUS venture with IBM will allow it to expand quickly.

DRAM drop

For companies that own their production lines, I continue to hold LSI Logic and would buy Integrated Device Technology and Cypress, suppliers of the fast, 1-Mbit SRAM chips that surround the Pentium processor. Both are well diversified, with significant non-SRAM revenue. Avoid Micron and Texas Instruments – I expect DRAM prices to dive this year.

Meanwhile, the server market should offer a 20 percent increase in stock prices. The recent growth in this area has been in big Unix servers for Fortune 500 client/server systems. While Hewlett-Packard, Tandem, Digital Equipment, and IBM all have competitive products, Sequent and Sun are not burdened by an installed base of proprietary systems.

However, Windows NT-powered NeTpower or Netframe servers are awesome competition for midsize Unix machines due to lower PC hardware cost and a huge software library. NT server sales exceeded Unix sales in the first quarter of 1996 and are widening their lead. I'm putting my money on Sequent and Netframe; each offers a robust architecture and full NT compatibility without the obstacles of a proprietary installed base. I'm also looking forward to a NeTpower IPO.

As the server market booms, demand for clients will follow. PC sales exceeded expectations in the December quarter, and in spite of some residual gloom and doom on Wall Street due to slower growth in the home computer market, I expect the industry to grow 20 percent in 1997. In addition to the Windows NT corporate upgrade cycle, Intel's new multimedia Pentium chip will set off a round of consumer upgrades. After two great years, home computing fell to about an 8 percent growth rate for the first three quarters of 1996. In 1997 I expect that rate to jump close to 18 percent. The corporate market will grow faster.

Companies in the lucrative software business should see a 30 percent rise in stock price. Microsoft continues to lead the industry. Some analysts estimate that the Gates empire controls more than 80 percent of the market for office suites.

Do Adobe

Although Novell sold WordPerfect to Corel, it's still losing to Microsoft in the LAN business – avoid the stock. Adobe, the biggest PC software company not standing toe-to-toe with Microsoft across most of its product line, plans major upgrades in fiscal 1997. Adobe is dusting its competitors in electronic publishing and is tied with Macromedia in multimedia. Given the Internet-driven growth in both of those markets, I am an aggressive buyer of Adobe and Macromedia.

The relational database vendors continue to thrive. Informix is well positioned after its purchase of Illustra Information Systems and is a good buy under $20. While Oracle has market share, it needs to rewrite its system to compete with Informix. Sybase also needs a rewrite – it is in deep shit.

TWIT$

TWIT$ is fully invested in stocks that look undervalued. ■ ■ ■

Michael Murphy is a money manager who publishes the California Technology Stock Letter *in Half Moon Bay, California.*

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Web advertising is now an US$80 million-dollar-a-year market, and @d:tech.97 provides meatspace for companies clamoring for even more online revenue. Unlike traditional media that broadcast a blaring brand identity, interactive technologies can – and should – mesh entertainment with service, support, and full-blown applications. Online advertising is more than business as usual.

"Customers will get what they want," says Poppe Tyson executive David Carlick. "And increasingly, they want Web sites that don't just show them a product but let them buy it and provide ongoing support. In computer markets, you'll see services literally become product extensions. Interactive users want quick response and relevant answers. Advertisers want targeting, interactivity, and relevance."

Direct feedback, demographic details, and accountability distinguish interactive media from their one-way broadcast ancestors. Furthermore, technologies such as intelligent agents, dynamic databases, and ecash promise advertisers a cornucopia of personalized content, boundless information, and real-time transactions. Webonomics clearly bears little resemblance to traditional business models. To help us understand this new topography, @d:tech.97 unites adventurous admen and prominent webheads, including @Home's Milo Medin, Firefly's Saul Klein, and Organic Online's Jonathan Nelson.

Another speaker is Forrester Research analyst Mary Modahl, whose recent studies on Web revenue indicate that the greater accountability offered by online advertising will engender a brutal digital Darwinism – while successful content providers will deliver an audience, the rest will perish. Click your way to Chicago and hone your survival skills for the brave Web world of the 21st century.

Registration: US$1,095 through March 7, $1,195 after. Contact: (800) 535 1812, +1 (804) 643 8375, email *skip@ad-tech.com*, on the Web at *www.ad-tech.com/*.

The Current Roundup (see *Wired* 5.01)
February 24-28 Financial Cryptography 1997; Anguilla, British West Indies. • **March 1-2** Convergence and Diversity: Pacific Asia in the 2020s; Wellington, New Zealand. • **March 3-5** ACM97: The Next 50 Years of Computing; San Jose, California. • **March 7-16** SXSW; Austin, Texas. • **March 11-14** The Seventh Conference on Computers, Freedom, and Privacy; Burlingame, California.

March 16-18 Telemedicine and Distributed Medical Intelligence Conference; Vail, Colorado Medical intelligence isn't just about acing Anatomy 101 anymore. Join world-renowned MDs Dave Warner and Robert Corona for an illuminating discourse on virtual reality in medicine, Web technologies in medical consultation, and the different models for telemedicine that can be used to treat patients in their homes, overseas, and across networks. Registration: US$675. Contact: +1 (919) 816 2695, fax +1 (919) 816 2495, email *training@sparky.med.ecu.edu*, on the Web at *www.telemed.med.ecu.edu/*.

March 20-21 Sixth Winlab Workshop on Third Generation Wireless Information Networks; New Brunswick, New Jersey If you consider the Net a tsunami of distributed information now, wait until satellite networks rain a hurricane of high-speed data down to your desktop. Presented by the brains of the Wireless Information Network Laboratory, this etherfest will demystify widely distributed personal communications, mobile computing, and multiple access networks. Registration: US$525. Contact: +1 (908) 445 5954, fax +1 (908) 445 3693, email *noreend@winlab.rutgers.edu*, on the Web at *winwww.rutgers.edu/pub/symposiums/workshop96*.

March 23-26 PC Forum; Tucson, Arizona Exclusively for subscribers of Esther Dyson's bleeding-edge newsletter *Release 1.0*, the PC Forum is a schmoozathon for élite technologists and Web entrepreneurs. Share your views on browser wars with Netscape's Jim Barksdale, dis proprietary financial networks in front of Michael Bloomberg, or wrangle some VC dough out of Kleiner Perkins big boy John Doerr. This year's topic, "The Living Web: Models & Metaphors," will come alive with the buzz of the Net biz. Registration: US$3,300. Contact: +1 (212) 924 8800, fax +1 (212) 924 0240, email *us@edventure.com*, on the Web at *www.edventure.com/*.

March 25-27 @d:tech.97; Chicago See information at left.

April 1-3 Gigabit Networking; Washington, DC Share the ultimate fat-pipe dream with networking pioneer Leonard Kleinrock and Gigabit Ethernet Alliance chair Tony Lee. Discover the time line for implementable Gigabit Ethernet products, learn what it takes to scale ATM to gigabit speeds, and find out how gigabit networking will affect visualization, animation, and desktop videoconferencing. This Technology Transfer Institute-sponsored speed council is the fast lane to the future of networking. Registration: US$1,095. Contact: +1 (310) 394 8305, fax +1 (310) 451 2104, email *custserv@tticom.com*, on the Web at *www.tticom.com/giganet*.

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April 16-18 European Symposium on Artificial Neural Networks; Bruges, Belgium. Contact: +32 (2) 203 43 63, fax +32 (2) 203 42 94, email *esann@dice.ucl.ac.be*. • **April 25-29** Computer Game Developers Conference; Santa Clara, California. Contact: +1 (415) 905 2702, email *cgdc@mfi.com*, on the Web at *www.cgdc.com/*. • **May 8-11** The High Frontier Conference; Princeton, New Jersey. Contact: +1 (609) 921 0377, fax +1 (609) 921 0389. • **May 11-14** Corporate Venture Capital: The Third Wave; Cambridge, Massachusetts. Contact: +1 (617) 495 6226, email *executive_education@hbs.edu*.

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Back to the Future in Chicago

Before the ad banner-site sponsorship debate, a battle raged between those who thought Ovaltine was the drink of the 21st century and those who believed Tang to be the taste of the future. This struggle is just a sample of the nostalgic collection of programming available at the Windy City's **Museum of Broadcast Communications**. After perusing the archives, reserve a spot in the Kraft Telecenter to anchor your own newscast. Or, open Fibber McGee's closet and set foot in Jack Benny's vault in the Radio Hall of Fame.

Escape back to the future at the **Museum of Science and Industry**. Check out the Omnimax film highlighting the science of Indy Car racing. Or discover the Communications Zone, an exhibit that explores the impact of information technology on our lives.

The museum's Working Options exhibit presents the office of tomorrow – that mythical day when all of your activities will be integrated into your PC. Perhaps these same computers will launch an IBM-Orbitz joint sponsorship that finally replaces coffee as the morning beverage of choice. – *Anne Speedie*

ILLUSTRATION: TONY KLASSEN

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The Fall of the House of Voyager

Since its inception in 1984, The Voyager Company has built a solid brand in the evolving medium of electronic publishing – but this has guaranteed little. Venturing into the largely uncharted multimedia arena, Voyager has experienced repeated conflict from the top down. Last November, company chief Bob Stein, who led Voyager's efforts into CD-ROM and Web-based content stepped down following his ex-wife and cofounder Aleen Stein's departure in 1995.

Bob Stein, widely viewed as the leading creative guru of the multimedia industry, is also seen as the digital pilgrim who landed in New York, set up shop at 578 Broadway in 1993, and sparked Silicon Alley's growth. Stein said he was looking for someone with whom he could either buy out the remaining Voyager partners or start a new venture. Stein added that Voyager has moved "to embrace the movie business," focusing on laserdisc rather than CD-ROM development.

During the decade's boom of venture-capital-funded high tech start-ups and inflated public offerings, Voyager's business has remained flat. Instead, creativity, not business savvy, has proven Voyager's prime commodity: non-mass-market CD-ROMs such as *Who Built America*? and Laurie Anderson's *Puppet Motel* were lauded as art objects, but only slightly boosted. Deflating the company even more, November's shake-up forced the layoffs of 20, shrinking the staff from last year's 100 to its present 45. Intellectual property has continued to suffer, as various Voyager offshoots have siphoned off company talent in recent months.

Voyager is owned by five partners – Aleen Stein, Bob Stein, Jonathan Turell, Bill Becker, and Verlagsgruppe Georg Hostzbrinck – each of whom retains 20 percent ownership.

Aleen Stein, who now runs Organa, a Manhattan-based multimedia firm, said, "Voyager is up for sale for the right price," but the buyer "has to be somebody who pursues the vision. The current crisis has brought things to a head in a way that will make all of us cooperate more to try to make a solution."

In the wake of the shakeup, Bill Becker's son, Peter, who had directed Voyager's Criterion Collection laserdisc, film, and video projects, was named president. Involved parties said Voyager would turn to the more lucrative film side of the business, centered on Janus Films – the laserdisc, classic movie archive, and distribution company started by Turell and Bill Becker that has long subsidized CD-ROM efforts. "The Criterion name is very valuable," one former employee said. "The big question will be whether the Voyager name has become a liability. If not, it can segue that laserdisc collection into a series of truly interactive CD-ROMs or DVDs."

Peter Becker said that, given its new focus, Voyager "will continue to develop interactive media that emphasize our library of movie- and art-related content." According to Becker, Voyager will still publish CD-ROMs, laserdiscs, and Internet content while moving into digital video and Internet commerce. Whether Voyager realizes its ever elusive "vision" remains to be seen.

– *Alex Frankel*

[ORIGINAL STORY IN *WIRED* 4.07, PAGE 126.]

Promo Must Go

A recent wrinkle in cyber law has grown out of the dispute between America Online and Cyber Promotions (formerly Promo Enterprises), the now-infamous brainchild of Sanford Wallace. A federal judge in Philadelphia ruled late last year that Cyber Promotions does not have the right to send unsolicited email to AOL subscribers, and furthermore that the case is not a First Amendment test, since AOL is a private company. Two days after the ruling, Wallace filed a motion claiming that AOL was violating federal antitrust law.

While many heralded this as a victory for AOL users (subscribers pay for time spent sifting through junk mail), a potentially sinister case law may be developing. The legal argument pivoted on the fact that AOL blocked Cyber Promotions's spams – before subscribers could view the messages. AOL's new mail program, PreferredMail, will allow users to bozo-filter for themselves and may make future arguments – and potential suits – moot.

[ORIGINAL STORY IN *WIRED* 4.01, PAGE 52.]

Fast Back

On October 28, at Black Rock Desert in Nevada, Craig Breedlove once again became the fastest man on earth. The title, however, is unofficial, because at 675 mph the car was tipped by a crosswind, sending Breedlove veering wildly off course in a desperate bid to bring it to a stop – a feat he managed miles later, after negotiating the world's fastest and largest U-turn.

Breedlove was unhurt; the car was trashed.

This setback was the crowning indignity of months of bad luck. Breedlove spent six fruitless weeks at Bonneville, plagued by bad weather, parachute problems, and salt corrosion. Environmental groups blocked his permit at Black Rock for weeks; by the time he arrived, winter weather was imminent. Knowing he had little time, he broke his own rule, ran with a crosswind, and nearly paid for it with his life. But within an hour of the crash, he was joking with supporters in the local diner and planning his comeback. "We'll be back here in June," he said.

[ORIGINAL STORY IN *WIRED* 4.11, PAGE 184.]

Universal Avatars

Since we last left the divergent field of virtual worlds, some of their creators have been conspiring to make visitors' experiences more uniform. But rather than compromise the surroundings and make them less robust or eclectic, creators will instead stabilize identities. Velocity Inc., Worlds Inc., Chaco Communications, and IBM are putting their forces together to create the Universal Avatars standard, which will be developed as an extension for VRML 2.0. (A competing proposal, called Living Worlds, has been in the works as well, but both share the same goal.)

Having a universal avatar would mean that, regardless of the virtual worlds users choose to inhabit, they'd be able to maintain an invariant identity, appearance, and set of belongings and preferences across those worlds. All of this has obvious implications in the marketplace and any other virtual space. Mark Pesce, the father of VRML, explains: "In the same way that your Social Security number acts as an absolute reference point in so many parts of your physical life, these avatar standards will create a way to establish that reference point in the virtual world."

[ORIGINAL STORY IN *WIRED* 4.06, PAGE 140.]

BACKGROUND ILLUSTRATION BY PAUL DAVIS; WALLACE BY BARUCH SCHWARTZ;
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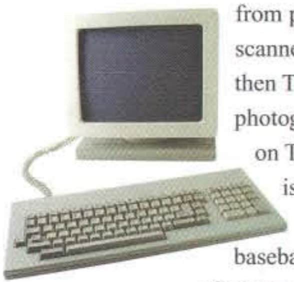

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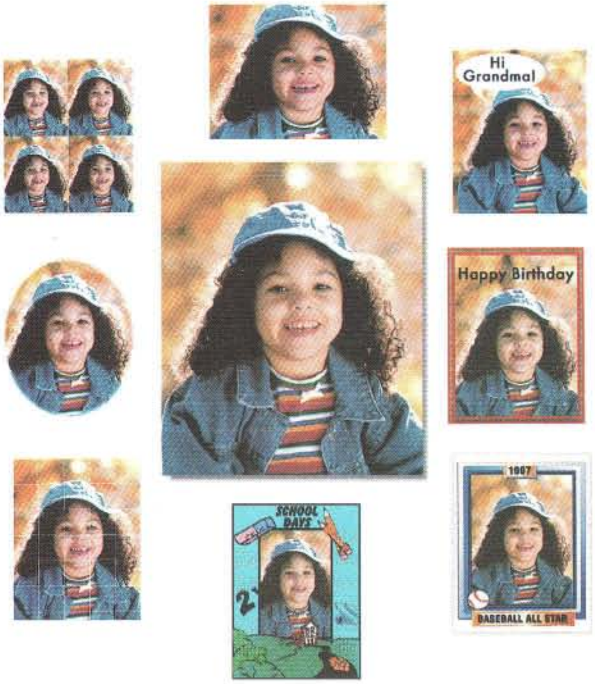

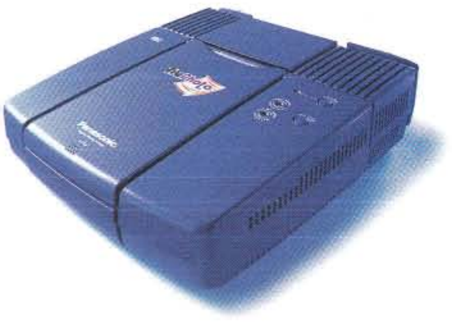

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Privacy: The Untold Stories

How the media miss the trees for the forest.

By Robert Ellis Smith

Last fall the British company that sells Burberry coats purchased credit reports on 190 million Americans from TRW Credit Data Inc. Chances are your credit history was one of those sold; I know mine was.

Curious why a foreign clothier now owns the financial profiles of 708 million people in 40 countries? Would you be interested in details about the reach of US consumer protections for credit reports? Want to know how the British company might use this credit information?

You'll have to search high and low to find the answers, because ever since the sale took place last November, no US newspaper, magazine, TV station, or radio station has pursued the story. News of the transaction appeared in the business pages of a few papers, but only because some Boston speculators made a killing by purchasing TRW's credit bureau earlier in the year and reselling it to Great Universal Stores of England – which owns Burberry's of London – two months later.

That's the way it goes with many important stories related to personal information and privacy – the press just doesn't cover them. Instead, reporters love to write ad nauseam on the Orwellian trend – saying things like, "Computer data banks threaten to invade the privacy of every man, woman, and child." Typically these tiresome trend pieces include a quote from an information manager who says, "You have to live in a cave if you want privacy today." And they'll always get comments from "privacy advocates" who plead, "It's like *1984*. They know everything about you. There's nothing we can do about it."

The dateline on these "view-with-alarm" articles could be 1977, 1987, 1997, or, I'm sure, 2007. The Orwellian trend story is easy to write, but it doesn't advance our knowledge of real threats to our privacy.

Some other examples of missed stories? In September, Equifax – one of the three major national credit bureaus – acquired an "information broker" named CDB Infotek, which sells credit reports as well as Social Security numbers, driving records, unlisted phone numbers, US Postal Service change-of-addresses, and demographic profiles of up to 30 of your neighbors. CDB Infotek is one of 16 information brokers – in a field of less than three dozen – that have been cited by state or federal authorities for violations of consumer laws.

The press missed this story entirely. Nor have you read about the Federal Trade Commission's lawsuit against Trans Union credit bureau to block the company's practice of renting information from your credit report to telemarketers and direct mailers.

Did you know that TRW changed its name to Experian last summer, to shake its negative image among consumers? That Congress now requires each state not only to demand your Social Security number when you renew your driver's license but to display it on the face of the license? That Citibank allowed the Secret Service to use the credit card accounts of real customers – without telling them – as bait in a sting operation? That beginning in 1998, thanks to Congress, you will need a universal patient ID number before you can get medical treatment anywhere, coast to coast?

One problem may be that journalists are trying too hard – they want to find the "privacy angle" but can't put their finger on it. So here's a suggestion: start looking for stories that shed light on emerging patterns in privacy issues. Let us know about the increasing foreign ownership of our personal data; the European advances in privacy protection that leave the US two decades behind; the covert and monopolistic attributes of companies that deal in personal information; the indifference that Congress and the Clinton administration display toward privacy issues; the possibilities for tracking Internet usage that are unfamiliar even to sophisticated Net users; the latest changes in telephone technology that make surveillance more likely and render the whole idea of "unlisted numbers" obsolete.

I was once asked by a newspaper editor to submit a story on what's hot in privacy – yet another Orwellian trend story. In the piece, I reported on "companies that compile investigative reports on insurance applicants by interviewing their neighbors and coworkers."

The editor pounced. "You can't just write this!" he complained. "You need proof. I've never heard of companies doing that." Of course, all he had to do was check his local Yellow Pages, or contact the Federal Trade Commission, or simply call Equifax, which controls 75 percent of the market for "consumer investigative reports."

A month later, one of his reporters called. "I'm writing a story about computers and invasion of privacy …" ■ ■ ■

Robert Ellis Smith (5101719@mcimail.com) *publishes the newsletter* Privacy Journal.

Not a Solution

Hewlett-Packard is doing its part to lend credibility to the Clinton administration's key escrow encryption proposals. In mid-November, HP unveiled its International Cryptography Framework – a system that will allow computer users "to select encryption algorithms and levels of security according to personal needs and government regulations." Of course, if your "personal needs" conflict with "government regulations," you can guess which comes out the loser. The proposal attracted support from the British and French governments, but in cyberspace news of the framework prompted calls for a boycott of HP products.

Sign, or We'll Sue

The Software Publishers Association wants your local ISP to work as a copyright enforcer. The SPA is asking ISPs to sign a code of conduct that includes naming a "copyright compliance officer" to peruse customers' Web pages looking for pirated material and links to sites that contain pirated software. The SPA claims the code is voluntary, but when one California ISP refused to sign, the SPA sued for copyright infringement liability. The suit was later dropped, but the SPA campaign continues. The Association of Online Professionals argues the code imposes "burdens and obligations that are not required under any existing copyright law."

Ratings Down Under

As part of a proposed code of practice for the Australian online industry, the Internet Industry Association of Australia (INTIAA) is recommending that online content providers voluntarily rate material according to the country's existing National Classification Code. Content rated R or X would be accompanied by "suitable onscreen warnings" and would be "managed by subscription enrollments" to exclude Internet users under age 18. American ISPs have long argued that no viable system exists to verify the age of Internet users, but the INTIAA seems unfazed. And its code of practice still offers no suggestions on how to implement an age-based ratings scheme.

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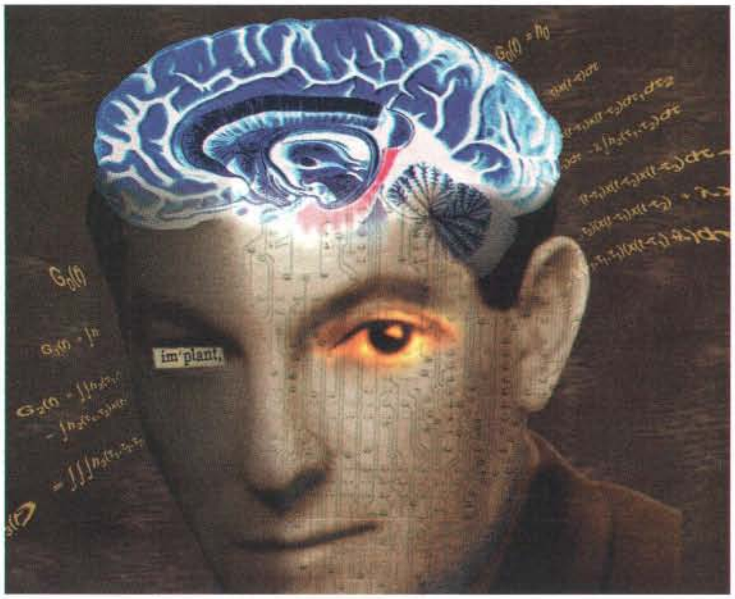
Head Start

Neuroscientist Theodore Berger is working real hard to be the first person to implant microchips between your ears.

By Samuel Greengard

www.wired.com/5.02/berger/

Clad in slacks and a dress shirt, Theodore Berger sits in his cluttered office, surrounded by the flotsam and jetsam of his work: modems, Zip drives, electrostatic bags, manuals, floppy disks, white cotton gloves, books. The intense neurobiologist is talking neurons and silicon chips, dendrite tissue and advanced photonics.



A team of USC researchers plays an elaborate game of copycat to build a chip that precisely mimics the brain's language, replicating neural functions without fully understanding how the results are achieved.

Beneath the wall-mounted photographs of brain tissue and schematic diagrams of VLSI chips sit a pair of Gateway 2000 Pentium PCs. Their hard plastic outer cases have been removed, the inside electronics ready for quick exploration. It's an unmistakable metaphor for a guy who finds the bony cranium an incidental obstacle to studying gray matter.

During the past four years, Berger and a seven-member team of scientists – experts in everything from semiconductors to the neurophysiology of tissue cultures – have worked ceaselessly at the University of Southern California in Los Angeles to unlock the brain's complex mathematical model so they can bridge the gap between silicon and cerebrum. "If we can speak to the brain in its own language then we begin to understand the biological basis of thought and learning," says the 46-year-old scientist. "It's a matter of understanding the way neurons act and react in every conceivable situation, then building a device that can duplicate their basic functions and transmit the appropriate electrical impulses."

If Berger can link the two – computer and brain – he may create a parallel-processing network that could function as a brain implant. Such a device would restore physical and mental functions lost to stroke, head trauma, Alzheimer's, epilepsy, and an array of other maladies. His plan to create a bionic brain is bold, brash, and just a bit, well, mind-blowing. Berger – scientist, tinkerer, dreamer – wants to be the man who implants microchips between your ears. And the amazing thing is that he just might succeed.

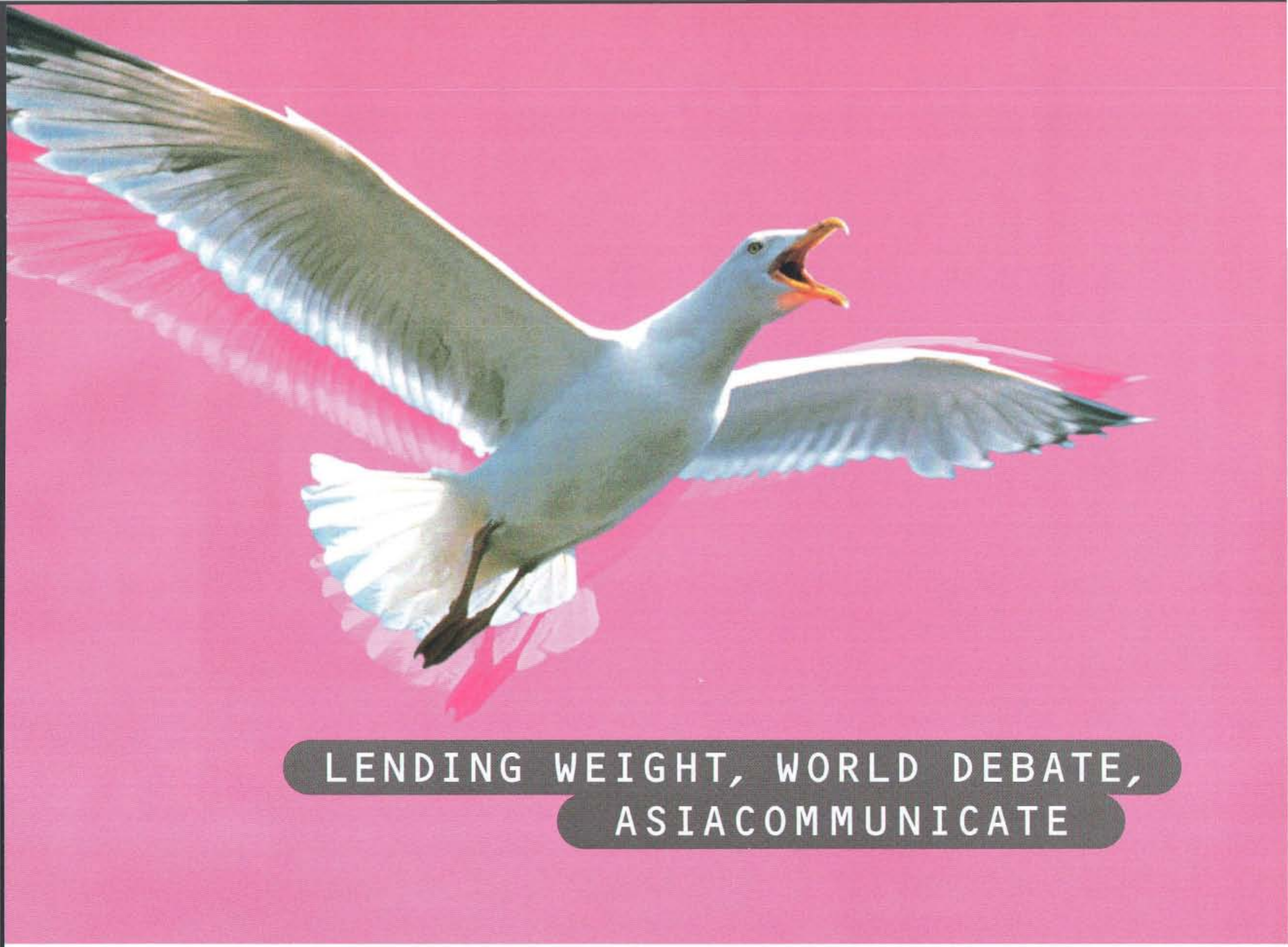
Simple problem, complex solution

Understanding the human brain is a formidable task. Parked inside the average cranium are between 1 and 10 billion neurons. Extensions called dendrites relay electrical impulses to other neurons, the brain cells that serve as the basic building blocks of thought and activity. The electrical impulses are carried on fibers called axons. The result is a neural network of remarkable complexity.

The power of neurons is that they can work together in different ways to produce speech, vision, hearing, and thought. Only when something goes terribly wrong are we aware of how serious it is to lose these connections. Only then are we able to recognize how difficult it is to regain what's lost and how much therapy may be required.

That's the part intriguing Berger, who earned his doctorate in physiological psychology in 1976 from Harvard University and has been hooked on the brain ever

IMAGE: PETER HORVATH



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since. Even in his early researching days at the University of Pittsburgh, when he first began to explore the idea of building a bionic brain, Berger found himself puzzling over some fascinating questions: If brain tissue dies, can it be replaced with a small computer that sends the same signals? Can we build an electronic bridge to restore the brain's full function? Says Berger: "The problem is simple; the solution is incredibly complex."

Neuroscience, a field that didn't exist until the mid-1960s, has struggled to map the human brain and comprehend how all the pieces fit together. It's analogous to a space alien dissecting computers, robots, and other devices stuffed with semiconductors. Without a road map, it would be virtually impossible to know what each chip does and how it interacts with other microprocessors.

A decade ago, when Berger began studying "wet" brain tissue taken from animals, he saw how little was known about the way neurons process information, or how populations of neurons can work together.

Alongside a workbench covered with beakers and tubes, a researcher (in the finest tradition of a Carnegie Deli chef) slices human brain tissue into ultrathin sections.

Although scientists know a great deal about the functioning of the individual nerve cells that compose the hippocampus - the part of the brain that oversees memory - there's still no clear idea of how their interaction produces the cognitive function known as learning. "A great deal of classical neurophysiology is devoted to trying to understand how the neurons process the signal and what the output represents," he explains.

That's not a nagging concern for Berger. Instead, he spends 12 to 14 hours a day identifying and cataloging predictable and repeatable neural electrical patterns, continuing a pattern of neural/technical intervention that has been explored for decades. In the 1950s, for instance, a stir was caused by a famous experiment on rats by J. Olds and P. Milner. Electrodes were implanted in each rat's lateral hypothalamus and connected to a stimulator that could be activated by pressing a small button. Since the electrical stimulation caused feelings of pleasure, the rats soon learned to stimulate themselves, choosing that button rather than another that would provide them with food, even when they were hungry.

A decade later, American neurophysiologist J. M. R. Delgado used stereotactic instruments to implant microelectrodes in precisely targeted areas within the brain. Their signals were transmitted wirelessly, making it possible to send high-voltage current. That led to drastic changes in emotional, sexual, and social behavior.

In one dramatic demonstration, Delgado implanted an electronic receiver in the medial region of the hypothalamus of a bull and then challenged the animal to do battle in a bullfighting ring. Delgado stopped the charging bull at the last minute by activating electrodes with a radio transmitter.

More recent experiments by researchers like Caltech's Carver Mead have shown that the elementary operations found in the nervous system can be realized by analog circuits created with standard silicon fabrication technology. Many neural areas are organized as thin sheets and carry two-dimensional representations of their computational space. These structures map well onto the two-dimensional silicon surface. Coincidentally, in both neural and silicon technologies, the active devices (synapses and transistors) occupy no more than a small percentage of the space - "wire" fills the remaining area.

Berger and fellow team member Vasilis Marmarelis, a professor of biomedical engineering, have built on those insights through an elaborate game of copycat, developing a complicated mathematical model that precisely replicates the input and output signals that a natural neural system uses. Just as a basketball player doesn't require a degree in advanced trigonometry to toss a jump shot through a hoop, Berger doesn't need to unlock the vast secrets of the brain to make an implant work.

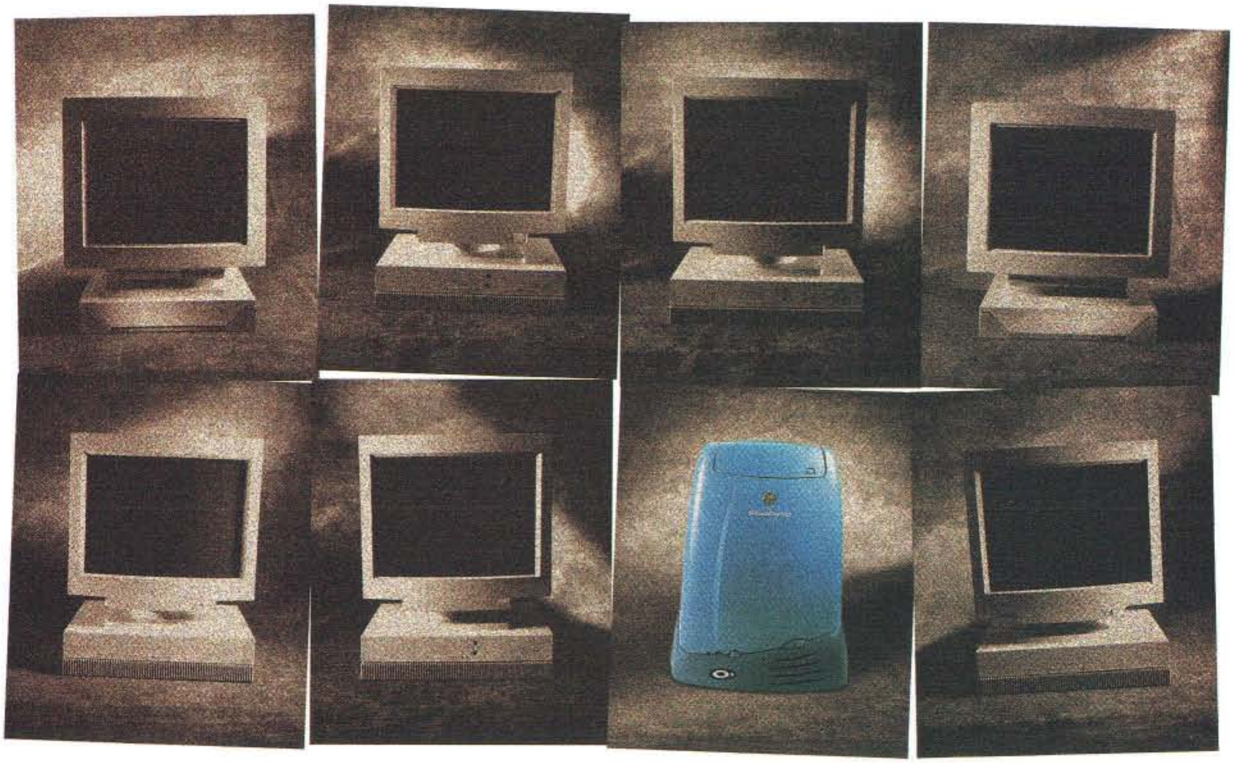
Wander into Berger's lab and you begin to see where he's going with all this. Alongside a workbench covered with beakers and tubes, a researcher (in the finest tradition of a Carnegie Deli chef) slices human brain tissue into ultrathin sections. These samples are then inserted into test tubes filled with oxygen and artificial cerebral-spinal fluid, which keeps the fresh tissue alive for several hours. The sample is transported to another part of the lab, where a series of electrodes and probes are inserted. This leads to a smorgasbord of electronic amplifiers and oscilloscopes.

For the next few hours, the tissue is subjected to a series of electronic impulses designed to simulate every possible combination that the brain can throw at it. A Pentium computer charts the data, creates a unique profile for each piece of tissue, and then slots the information into an enormous database.

Berger & Co. repeat this process thousands of times. It's not enough to know how a piece of brain tissue reacts to different circumstances. They must understand the *range* of responses to the same stimulus at different times.

Hardwiring the head

Constructing a brain implant is more than a meat-and-test-tube operation, however. Even with a growing understanding of the mathematics involved in driving such a system, today's digital microprocessors are not fast enough to execute the complex instructions in real time. Minutes, hours,



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even days could elapse before a software-driven brain implant could process even the most basic task, such as moving a finger that has been paralyzed by stroke or restoring a fragment of memory lost to Alzheimer's. Imagine trying to surf the Web on a 300-bps modem or commute to work in a go-cart. Possible? Yes. Practical? Definitely not.

That's where silicon and hybrid analog/digital microchips enter the picture. By hardwiring the algorithms that represent, say, 100 neurons onto a microchip, it is possible to rapidly accelerate the data processing. A calculation that might have taken 10 seconds or more in the past is now completed in only about 100 nanoseconds. What's more, these neural microchips can operate as parallel-processing devices.

But there's still a long way to go. Putting the function of perhaps 100 or 200 neurons on a single chip and then hardwiring tens of thousands of chips together would replicate only a fraction of the 4 or 5 million neurons in the hippocampus. You'd need an implant device the size of a pickup to get anywhere near the processing power of the brain.

Crosswiring brains and bytes isn't for the faint of heart. It's not difficult to let your imagination run amok and imagine a crazed zombie out of a Boris Karloff flick.

Armand R. Tanguay Jr., director of the Center for Neural Engineering at USC and a key member of the team, hopes to solve the scaling and bandwidth problems through a combination of holography and laser optics. By using light signals to replace physical wiring, it's possible to tightly stack 1-by-1-centimeter chips, which can then communicate with each other. This tiny parallel-processing network potentially allows for real-time response, and might eventually fit into a space the size of a peanut or, more important, the human skull.

Such an implant could be tailored to replace a lost ability in humans. "Because the brain is such an adaptive organ," Berger says, "the device wouldn't have to precisely mimic the lost functions. If the brain is provided with a basic set of instructions, it would fill in the blanks and regain the lost functions. Over days and weeks, the person might make a full recovery."

It's tough, time-consuming work, but engineering an implant from the silicon up is a bit easier when you've got your own photonic fabrication facility on the premises. Just a few hundred feet from Berger's lab is a US$10 million setup that has the ability to make the photonic elements that "wire" the silicon chips together, as well as the multielectrode probes that act as an interface between living and man-made neural circuits.

Surrounded by an array of equipment that would seem more fitting in Silicon Valley than downtown LA – including a bonding machine and clean room that can filter down to 10 particles per cubic foot – assistant professor Chris Kyriakakis shows off a hybrid optical electronic device that contains a set of stacked chips. "It has the built-in electronics to power the entire device," he explains. "The first chip drives another optical chip that can modulate light. Ultimately, that's what runs the tiny computer network."

The final and most difficult step is placing such a device inside the skull and connecting it to a living brain. Crosswiring such wildly divergent universes – one brains, the other bytes – isn't for the faint of heart or the intellectually timid. It's certainly not difficult to let your imagination run amok and conjure up an image of some crazed zombie straight out of a Boris Karloff flick. But Berger is no Boris. Although Berger eschews much of the conventional wisdom that permeates the rarefied field of neuroscience – particularly traditional reductionist thinking that says every piece of the puzzle must be fully understood in order to build a scientific model – he also knows that it's crucial to retain credibility within the discipline by adhering to accepted standards and practices.

You might call his attitude skeptically reverent. "History is littered with the debris of firmly established explanations that have suddenly been overturned by new information," he says. "There are countless cases where humanity believed that an explanation was absolutely right, and then someone else came along with a radically different explanation that washed the old theory down the drain. So, it is very difficult to accept the truth of the day. It's crucial to look at various perspectives and explanations, to always keep the big picture in mind."

Berger seems to do that pretty well, though his approach perturbs some in the scientific community. Having grown up in a household that placed a high premium on introspection and accomplishment ("Not necessarily the accomplishment that comes with dollars, but the accomplishment of having an impact on the people around you," he explains), and with a father who helped pioneer transistor research at IBM, he realized early on that he wanted to make a real difference in the world.

Berger studied mathematics and psychology at college but shied away from a career in psychology, opting instead for the hands-on world of neuroscience. "I realized that psychology doesn't have the tools to fully understand the cause and effect of behavior," he says. "It is a very incomplete part of the puzzle."

Fast-forward a couple of decades, and Berger's life puzzle is mostly assembled. He lives in a pleasant split-level home overlooking the bluffs and beaches of Palos Verdes, commuting the 40 minutes to work in a 1992 Honda Accord. He spends spare moments gardening or tinkering with com-

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puters; both allow him to further explore elaborate relationships as well as evolution. Then there's his wife and his 7-year-old daughter, the latter serving as his most prized experiment. "Watching her brain develop is fascinating," he observes. "You realize that there are some things you can influence and some things you can't. You can try to teach something to someone, but if the brain isn't ready or willing to accept it, it ain't goin' in."

Which is precisely the challenge of Berger's odyssey into the mind. Dropping a functioning brain implant into a person's head and expecting it to work requires a voyage beyond the flat earth of today's neuroscience. For starters, the shape of the hippocampus doesn't remotely resemble a computer board, so inserting a conventional microchip into the brain and trying to send electrical waves back and forth would be like speaking into a telephone that's not connected to anything. Berger has circumvented this problem with a digital interface chip that will serve as the gateway between the brain's cells and the stacked set of chips that creates a group of artificial neurons.

Since transistors and neurons both send and receive electrical signals, it all boils down to arranging the chip's conductors in a pattern that matches the layout of neurons in a particular part of the brain. The brain then believes it's receiving its own signals, when in fact they're originating from the computer network.

"A transistor can send electricity and so can a neuron," Berger says. "So, instead of using a computer chip that has transistors on it, you build a chip with a piece of exposed metal. You place the metal right next to the neuron, so that it can sense the electrical signals sent out by the neuron and send signals to the neuron." By slightly overbuilding the device – designing a layer of electrodes that are perhaps 30 microns thick compared with the cell's layer of 20 microns – Berger increases the odds of a successful contact.

"The ever present scaling issue"

In almost all cases, electrical signals trigger the release of chemical reactions in the brain, which in turn stimulate other cells to produce electrical reactions. These result in additional chemical activity. In fact, Berger points out that cells cannot talk to each other without the release of chemicals that effectively bridge the gap between neurons. So, the brain implant would need only to stimulate electrical activity to work. Many chemical imbalances would still be treated by medication, which allows the brain to restore the proper electrical activity.

With all the parts in place, Berger will have essentially created a circuit between the device and the gray matter that operates much like a dedicated phone line.

With all the parts in place, Berger will have created a circuit between the implant and the gray matter that operates much like a dedicated phone line.

Brain cells could actually grow on top of the silicon or metal surfaces, further blurring their distinction. A pair of the team's scientists – Michel Baudry, a professor of biological sciences, and Roberta Brinton, an associate professor of molecular pharmacology – have begun developing such cultures with animal tissue. When their research is finalized, says Berger, "We will have created a physical connection, or synapses, between the brain cells and computer chips. We have the basic ingredients for a brain replacement."

The most remarkable aspect of all, says fellow team member Tanguay, is that such a device represents the sheer oddity of today's science. Increasingly, researchers are able to find solutions without fully understanding the underlying process. "We may never really know how the brain works, but we might be able to understand enough about how neurons correlate and work together to run the mathematical model," he explains. "By connecting a silicon neural circuit to a probe chip and allowing it to 'learn' and then feed data back, it's possible to diagnose and fix the problem without having a clue how the system achieved the results. The brain would use its natural adaptive abilities to reestablish all the correct connections."

In other words, the device could learn the brain's native language and speak it, but not interpret it to the outside world.

The research is also yielding data that can be plugged into an array of other, seemingly divergent, scientific disciplines. Says Joel Davis, program manager at the Office of Naval Research: "Once you understand the algorithms that drive the brain, you can apply them to all sorts of real-world problems that require computing. You can use reverse engineering to solve problems in communications, sonar, and neural networks."

One spin-off has been a new type of parallel-processing network that could dramatically improve the quality of wireless and cellular communication. By embedding an existing algorithm in a microchip that mimics a biological model, it is possible to drastically reduce the effects of noise and distortion. Yet another prototype design, which used the same biological processing model, promises to improve speech recognition.

Of course, connecting all the dots on the brain implant remains the team's central focus – and their enormous challenge. For one thing, there's a dizzying array of experimental technologies that must intertwine and complement one another perfectly. It's one thing to create computer simulations onscreen in a highly controlled environment, but it's quite another to make them work in the real world of chemistry, biology, and neurophysiology. Stimulating a neuron or two in the brain is a pretty

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good achievement but mere child's play compared with stimulating thousands of neurons and running electrical channels through each.

Then there's the profound question of how many artificial neurons scientists can fit on a microchip, and how many chips they can pack into a cranium. "The ever present scaling issue," as Tanguay puts it. Even the simplest prototype versions of the device will require far more exotic and sophisticated chips and interconnections than the group has so far managed to design and build.

Alas, there's also the humbling reality that if any member of the highly skilled research team drops out or dies, the project could quickly crumble. So far, the team has steered remarkably clear of ego and turf battles, but the irony remains inescapable - the development of what could be the most advanced parallel-processing network on earth hinges on the most basic and tenuous: fellow humans.

Berger believes the team is about five years away from designing a brain implant for animals and about 10 to 15 years away from the first device for humans. With custom microchip designs taking weeks or months and other technical hurdles at every turn, it's certainly not a project for anyone with less than the patience of Buddha and the persistence of someone who sells insurance.

That suits Berger just fine. Nobody ever said that building an electronic brain would be easy, and it's clear that he's just as infatuated with the process as with the thought of changing people's minds.

"You build it neuron by neuron and chip by chip," he says. "You enjoy each experiment and piece of the puzzle while keeping a focus on the bigger picture." Berger won't rest until he has built a bionic brain. He definitely wants to get inside your head. ■ ■ ■

Samuel Greengard (samuelg@deltanet.com) *is a Burbank, California writer specializing in science and technology.*

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Hart of the Gutenberg Galaxy

What kind of a man wants to put the 10,000 most important books online by 2002 and make them available for free? (Hint: the kind of man who puts sugar on his pizza.)

By Denise Hamilton

www.wired.com/5.02/gutenberg/

Michael Hart has spent the past 25 years pushing a shoestring project named after the 15th-century inventor of the printing press. It's one of civilization's oldest dreams: a universal, free library. And it's got a really long way to go.

GUTENBERG: ARCHIVE PHOTOS

I am sitting with Michael Hart at Garcia's, a pizza place near the University of Illinois at Champaign-Urbana, where we are having a perfectly normal conversation about digital libraries and are preparing to tuck into our dinners. Hart is an e-text visionary and cofounder of Project Gutenberg, whose aim is to put copies of the world's greatest books on the Net for free. Hart is also a world-class eccentric with the social skills of a cranky 2-year-old. As I look up from my glistening pepperoni, Hart, who is 50, does the damnedest thing I've seen done to a pizza. Tearing open two dozen sugar packets, he sprinkles them methodically over his deep-dish pie until it is layered with white crystals. Then he digs in.

"This may seem weird to you," he confides between mouthfuls, "but it's the only way I can get enough fuel to keep working. This right here is 2,000 calories, and it should keep me going for a while."

Then the sugar begins coursing through his system, and Hart takes on the bug-eyed look of someone who has just hoovered up a few fat lines of Peruvian flake. The words tumble out. Sweat beads his upper lip. "Aaaah," he says, leaning back in the wooden booth. "I love working till I drop. I love looking back on the day and knowing I put another book online. That's what I'm here for. If I feel like I'm crashing, I eat. If that doesn't work, I sleep. I live by the nanosecond and burn the candle at both ends. With a blowtorch."

For more than a quarter century - eons, in Net time - Hart has made Project Gutenberg his mission in life. Or, more accurately, his fervid, manic obsession. While other geeks have grown rich mining the silicon motherlode, he's been sitting like a troglodyte in his Urbana basement, tending a utopian vision named for the 15th-century German printer whose amazing invention first made books accessible to the masses. As the 20th century wanes, Hart is using the Internet to try to finish what Johann Gutenberg started, pumping into cyberspace digitized copies of *Rebecca of Sunnybrook Farm*, *Moby Dick*, and *Orlando Furioso* and the works of Henry James, Plutarch, and Dostoyevsky - basically, any and everything that's ever been published between hard covers. It's one of civilization's oldest dreams: the universal library. And in an era of ever slicker Web graphics, blinking GIFs, and Java-powered billboards, he's doing it with militantly plain ASCII text files - just the words, please - downloadable anytime anywhere in the world by anyone with a functioning computer, a phone line, and a modem. No ads, no credit card numbers, no charge.

Even by the Net's generous standards, Hart is a wild romantic. He refuses to keep usage logs. He's not a big fan of copyright extension laws. He considers the Web an appalling waste of bandwidth - Gutenberg's main files reside on an FTP site. What passes for organization is a loose network of volunteer typists, scanners, editors, and proofreaders, plus a couple of pro bono attorneys, all held together by email. Other than that, Hart operates with something pretty close to no

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strings attached - political, institutional, or otherwise. Not that a lot of the groups that share his aims would have him.

Since Hart first typed the American Declaration of Independence into a U of I mainframe 26 years ago, Gutenberg has put about 1,000 titles online, on a budget smaller than some big-time electronic publishers allocate for market research. His self-imposed goal is to reach 10,000 books by the end of 2001, Gutenberg's 30th anniversary. And with 9,000 to go, the questions rise like the greasy steam from our pizzas: Is Hart a deluded crackpot, a high tech saint, or just another Net eccentric? And what is a project with seriously historic ramifications doing in the hands of someone who puts sugar on his pizza?

To find out, I'm pulling up outside the big, century-old, ivy-covered brick house that Hart bought years ago with a modest inheritance. In my honor, he's wearing slacks but quickly changes into the uniform he will sport for the rest of my three-day visit: black bicycle shorts that emphasize his pot belly, a red T-shirt, a baseball cap, and Nike Air Jordans two sizes too big that cost US$1 at a garage sale. Beneath the cap is short, thinning hair. He has a booming laugh and a large, clean-shaven fleshy face with graying sideburns. When I ask to use the bathroom, Hart gestures into the basement, past peeling plaster and ancient caulking. "Don't bother flushing," he hollers down. "I've got a garden hose, and I'll just run some water through it."

Hart foresees tribesmen in Borneo's rain forest, armed with a cheap laptop and modem, clicking onto Gutenberg and downloading texts.

I begin to realize that this is a man with clearly defined priorities. "Other than to redesign democracy, I can't think of anything more important than Gutenberg," Hart tells me when I return. "It's the Archimedes lever: Give me a place to stand, and I'll move the world. Well, that's what I'm doing. Our goal is to give away 1 trillion e-text files by December 31, 2001. That is 10,000 titles each to 100 million readers, which is only 10 percent of the present number of computer users. Since that number will double by 2001, we will meet our goal if only 5 percent of all users download a file." Easy as that.

Hart calls himself an electronic Johnny Appleseed, sowing the Internet with books for the global proletariat. He foresees the day when, armed with the trashiest laptop and a modem, tribesmen in Borneo's rain forest will be able to click onto Gutenberg and download texts. But why would anyone want to read a book on a computer when they can hold a bound copy in their hands, I ask. Because it's fast, convenient, and free, Hart shoots back, along with a list of the people who are using Project Gutenberg already: Kids doing research for classes. People in foreign countries who want to practice English. Grandmothers turning their computer-savvy grandkids on to *The Jungle Book*. Folks looking for rare Robert Louis Stevenson volumes - Gutenberg has the author's entire 30-plus volume oeuvre - not carried by their local library or bookstore. And people like Jo Churcher of Toronto, who is blind. She downloads Gutenberg texts and runs them through a speech synthesizer that reads them out loud, like books-on-tape, only free. "Gutenberg has finally allowed blind people to begin building up libraries of their own," says Churcher, who likes the project so much she has helped scan in 12 books, including *The Pickwick Papers*, for Gutenberg's files.

We move into Hart's living room, a dimly lit cavern piled with modems, computer cards, hard drives, videocards, and power supplies, all leaning drunkenly against each other. There are hundreds of boxes of software; thousands of records; CD-ROMs and CDs; moth-bitten beaver, mink, and monkey coats; hippie op art; what Hart says is an original Modigliani; a gaily painted child's hobbyhorse; a Cable piano from the 1910s; a Thomas Edison Dictaphone from the '30s; and rooms filled with books, including 50 complete dictionaries, three copies of *Chaos* by James Gleick, and nine of *Mistral's Daughter* by Judith Krantz. "She's usually a ditz," he explains, "but this was a good book."

Hart is a garage sale fanatic, hitting up to 100 each weekend as he criss-crosses the leafy suburbs of Champaign-Urbana on a bicycle (he doesn't have a car). He also forages daily among neighborhood dumpsters, where U of I students routinely discard stereo components and new floppy disks. But his favorite dumpster is located behind the U of I computer lab. We drive there, and Hart hops right in, wallowing thigh-deep amid pizza cartons and plastic milk bottles because he knows the school often throws out old equipment, stuff he can use for Gutenberg or trade at the weekly "geek lunch" he attends with other tech-heads in the U of I orbit. Today, he fishes out a set of Unix manuals, an 8mm tape cartridge, and two copies of *Mathematica*, for Sun's Solaris operating system. Slim pickings. Nothing like the time he scored an entire ATT 7300 minicomputer.

Hart doesn't need high-end stuff to run Gutenberg - it's just nice to have around. Every few years, he gets a computer from Apple, NeXt, IBM, or Hewlett-Packard. Bell & Howell once donated a $50,000 scanner, to help volunteers input books quickly. And he's thinking about setting up an email server, so he can offer free accounts to Gutenberg volunteers. Just talking about the idea gets him giggling with glee.

As a child, Hart's idols were Peter Pan and Albert Einstein. In adulthood, the two have twined like a double helix to define his personality so that within one conversation, he can go from visionary brilliance to bluster to bumble. "Michael is one of the

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smartest guys I've met in my years," says Greg Newby, an assistant professor and assistant dean at the School of Library and Information Science at the U of I and a senior research scientist at the National Center for Supercomputing Applications. "He's also one of the least mature. That makes for an interesting combination."

Hart grew up in Tacoma, Washington, where his parents worked as government codebreakers during World War II. In peacetime, his father was a Shakespeare professor and a CPA. His mother was a math and education professor and ran a women's clothing store. Dyslexic but precocious, Hart was messing with algorithms while other kids were fumbling with Lego. He plowed through the U of I in two years, graduating first in his class with a self-created major in man-machine interfaces. Hanging around the university's computer lab after graduation, he dreamed of a universal digital library and posted an e-text manifesto that grew into Project Gutenberg. With the US bicentennial looming, he chose the Declaration of Independence as his inaugural text – he also happened to have a copy of the text in his backpack. Next he did the Bill of Rights, then the Gettysburg Address. But the project moved sluggishly because Hart inputted everything manually after his day job of selling stereos.

When a fresh new book file arrives, he'll wake at 3 a.m. and sit before the glowing screens in a sweatshirt resembling a hooded monk's cowl.

In those early mainframe days, Hart had to operate within the impracticable bounds of a 10-Kbyte donated storage space. But as computers got faster and smaller, Gutenberg began to look more like a real possibility. Things really broke loose in 1988, when Hart typed in his first full novel, *Alice in Wonderland*. Mark Zinzow, a senior research programmer at the U of I who met Hart that year, remembers thinking that the project – which at the time had 10 books online and a 1200-baud connection – was completely harebrained. "But it was also a noble goal," says Zinzow, "and I thought, If he wants to tilt at windmills, I'll help him get on his horse."

Although Hart no longer had a formal affiliation with the university, Zinzow gave him access to email and mailing lists, and more important, an FTP server. Soon, he was watching in amazement as Gutenberg pumped out a gig of data each day. Around the same time, Hart was invited to place his digital collection under the official auspices of the Benedictine University, a tiny Roman Catholic seminary in nearby Lisle, Illinois. The symbolism did not escape Hart: monasteries had once been repositories of knowledge in the Dark Ages, copying and preserving books for posterity. Wasn't Gutenberg doing the same thing electronically, preserving e-texts long after paper and microfilm would crumble into dust?

The monks went even further, naming Hart an adjunct professor of electronic text and giving him a $12,000 annual salary. They kicked in some extra money for living expenses, most of which eventually came from sales of a Gutenberg CD-ROM that has hit 100,000 copies. (Regularly updated, the current edition boasts more than 500 titles, on a single disc.)

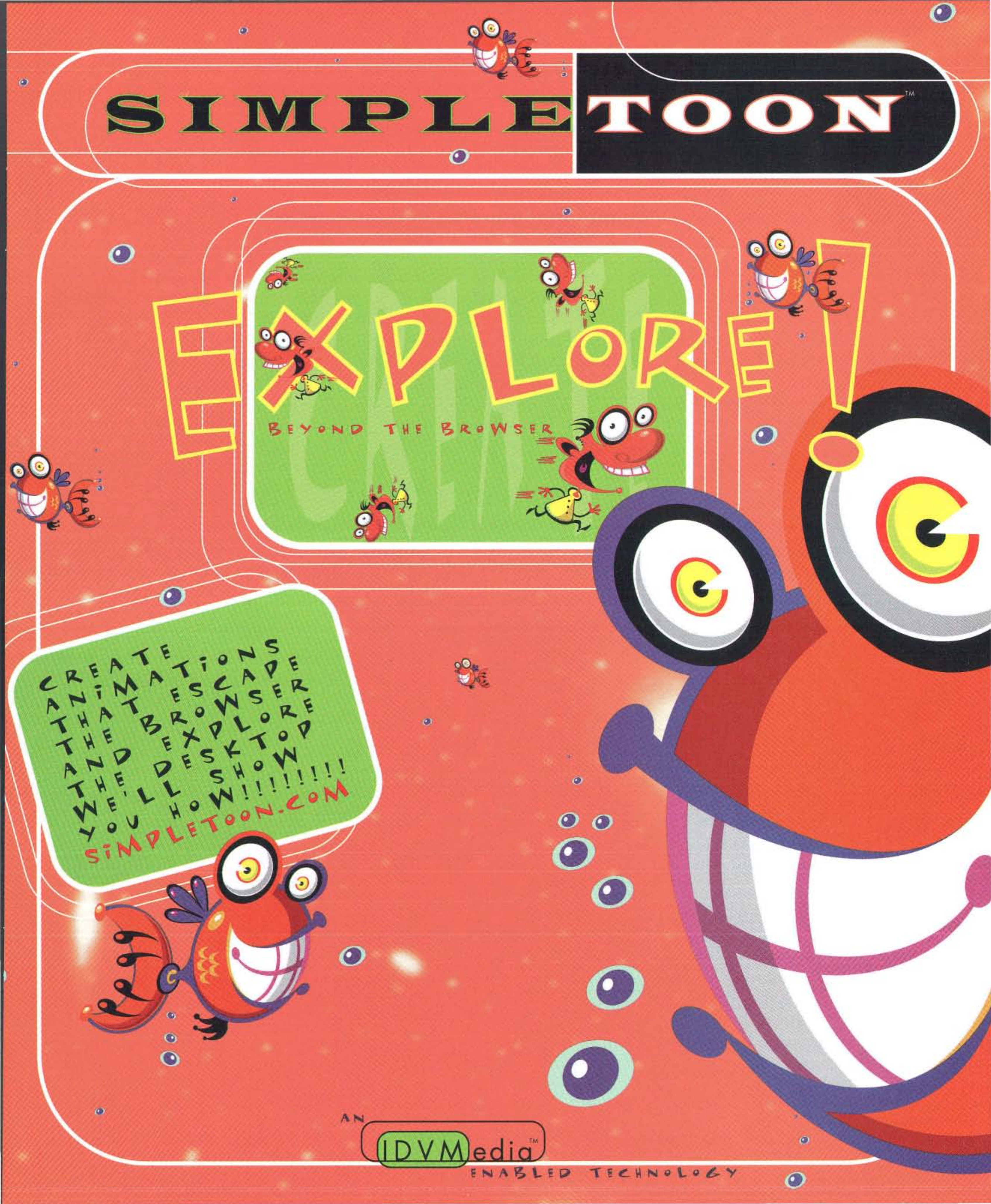
As the project grew, Hart's management style stayed laid-back. He refused to draw up a master list of books for the Gutenberg pantheon, preferring to let volunteers input their favorite tomes. Initially, Gutenberg got the usual suspects – the Bible, Virgil's *Aeneid* (in English and Latin), and *Hamlet*. Then came more unusual fare: *The Book of Mormon, Herland* (a 19th-century feminist novel), and *Flatland* (science fiction, about 4-D travel). Deadlines were flexible. There was no follow-up. Sometimes the e-texts arrived months or even years late. Other times, they just dropped into limbo.

What keeps things going is Hart's fanaticism. A DOS man and a neo-Luddite when it comes to GUI interfaces, he says he's never even used the World Wide Web – he doesn't like the graphics. But the five machines that make up Gutenberg Central boot so fast you can barely see the start-up box flash by. And when a fresh new book file from a volunteer comes in on a winter night, he'll wake at 3 a.m. and sit before the glowing screens in a sweatshirt resembling a hooded monk's cowl he got from the Benedictines. In summer, he works in nothing but biker shorts, blasting classical music or classic rock. To get his Vitamin D and avoid rickets, Hart relies on a full-spectrum lamp that mimics the sun's rays. Nearby is a rumpled mattress where he sleeps when felled by exhaustion.

When I visited, he was proofing *The Violet Fairy Book* – a 1901 collection of stories edited by Andrew Lang – and checking that the format, spacing, and margins conform to official Gutenberg style. After scanning for errors, he adds a header – "Welcome to the World of Plain Vanilla Electronic Texts. Readable By Both Humans and Computers, Since 1971" – includes some boilerplate legal information, and updates his directory. Then he hits Enter. Bing – the book is in an FTP site on PrairieNet, a community access computer system in the Midwest. From there, it will ripple around the world, to interested individuals, literary Web sites, and other digital libraries.

Hart has to keep working, or he'll drown in data. Each day, he receives up to 400 pieces of email, chats with dozens of volunteers, and works on upcoming books. Besides running Gutenberg, he's also the central figure behind "Ask Dr. Internet," a free service run by a Gutenberg-like group of tech-heads that has evolved into its own full-time job. Even the most clueless AOL newbie gets an answer – often with a liberal icing of Hart's own curious views about things like the Web and graphical interfaces.

With Gutenberg, he gets help from 750 volunteers around the world. Lawyers work



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pro bono, researching a book's copyright to ensure it has entered the public domain. Tech-heads like Zinzow provide sysadmin consulting and tend computers held together with gum and baling wire. Scholars input and proofread e-texts. A group of 50 Russian academics, for instance, recently did *Webster's Unabridged Dictionary* by hand. The 45 million keystrokes took them six months, for which they were paid $5,000 by one of Hart's financial supporters.

Some texts are labors of love, by volunteers who tap along for years to finish one title. But most of the heavy lifting is done by a hardcore group – mainly academics – with access to state-of-the-art laser scanners. Geoffrey Pawlicki, a longtime supporter who put Shakespeare's *Antony and Cleopatra* online, recalls meeting Hart in 1980: "He had files in a backpack and was always running around hooking people up with modems. Initially he was dismissed as a crackpot, but the same could be said of Ted Turner."

Not that Project Gutenberg's founder and a media mogul are likely to ever be confused – for starters, Hart's totally uninterested in tracking Gutenberg usage. "I don't care where a book goes," he says, "I just want it to sprout legs and run." He knows that 10,000 files are downloaded daily on the U of I server, but that doesn't give the whole picture since the archives are mirrored on hundreds of sites the world over and heavily redistributed. (The New Zealand Digital Library, for instance, boasts 492 Gutenberg titles in easy-to-use HTML.) Many users post Gutenberg texts on their own Web sites, so Hart's work can be found on Tarzan sites, Shakespeare sites, and *The Jungle Book* sites, to name just a few.

The only thing Hart asks is that anyone who uses a Gutenberg text tack on a "small print" header that says in part: "Why is this 'Small Print!' statement here? You know: lawyers. They tell us you might sue us if there is something wrong with your copy of this e-text, even if you got it for free from someone other than us, and even if what's wrong is not our fault. So, among other things, this "Small Print!" statement disclaims most of our liability to you. It also tells you how you can distribute copies of this e-text if you want to."

One result is that Gutenberg texts reach people who have no idea what an FTP server is, let alone how to use one. Hart gets a lot of email from the United States, Britain, Canada, Singapore, and Germany, so he assumes those are big markets. Many people comment on the *CIA World Facts Book*, so he thinks that's his most popular book. (It's updated annually, and he can put it online immediately because government publications are public domain.) Other favorites seem to be the Bible, *Alice in Wonderland*, and the collected works of Shakespeare.

But even broaching the idea of doing more to find out what people might want from Project Gutenberg makes Hart see red. He imagines the sinister implications of tracking folks who want to download, say,

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Salman Rushdie's *The Satanic Verses* in a country like Iran. And besides, any effort to "steer" the project misses an essential point. "Once we put a book out," he says, "it goes everywhere there are computers and readers. That's unlimited distribution. And in a world based on competition for everything, that's the biggest threat."

So in one sense, Hart is an electronic David, striking a literary blow against an establishment Goliath that tries to control information through restrictive copyright law, downloading fees, and red tape. And for that, he has a lot of fans. "Michael's one of the few people I know who's not motivated by greed," says Zinzow. "He's trying real hard to do a good deed for the world, and he's really underappreciated. If Michael wasn't here, access to books on the Internet would be only for the rich. He's an electronic Robin Hood, keeping the Sheriff of Nottingham from creating a monopoly." Newby agrees. "When you have Microsoft buying up the right to thousands of art images, and the federal government taking away copyright, going backward and copyrighting things that weren't copyrighted before, it's not just paranoia; he's trying to fight the evil forces."

Hart is happy to agree. "Some people say, 'I am the most powerful because I have the most power.' I say, 'I am the most powerful because I give the most power away.'" And there's no reason to doubt that his dogged pursuit of that ideal is one of the things that has enabled Gutenberg to survive all these years. The project has doubled each year since 1991, when he had 12 books online, and the way Hart sees it, Gutenberg should continue to do so. That means 1,600 books for 1997, 3,200 for 1998, and so on.

"Some people say, 'I am the most powerful because I have the most power.' I say, 'I am the most powerful because I give the most power away.'"

But there are limits to what he can do without institutional backing and only a handful of hardcore volunteers. Even supporters like Newby say the man can barely handle his current workload and will be hard-pressed to take on more unless he delegates authority. Lately Hart's been trolling the Internet for someone to pass the torch to. But it's hard to imagine him letting go. "No one wants to be a supervisor, so I have to do it all myself," he says plaintively.

Hart also refuses to waver from his initial vision, and this has limited his scope. If he made some concessions, it's possible

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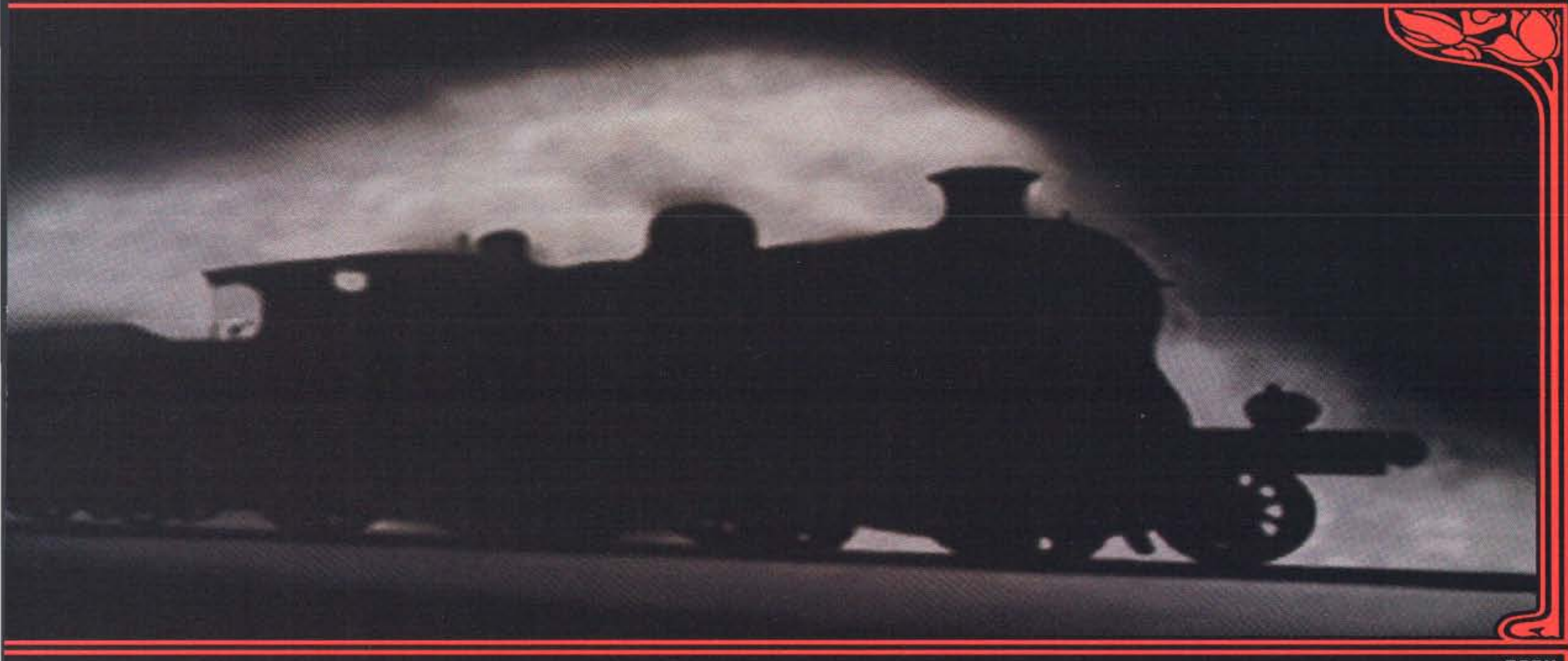

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Gutenberg might have 100,000 books online today - a respectable library - instead of 1,000. Indeed, Hart says, various academic institutions and even some Texas oil interests have offered to bankroll Gutenberg over the years, in exchange for control. One university offered him a six-figure salary, he says, to bring the project to their campus. He turned them all down flat. "Almost everybody out there wants to charge for books, and they want real control over which books we do and which edition comes out," Hart grouses. "They want a bit in my mouth. I don't trust them."

Texas oil interests offered to bankroll Gutenberg. One university offered Hart a six-figure salary. But he turned them all down – they wanted control.

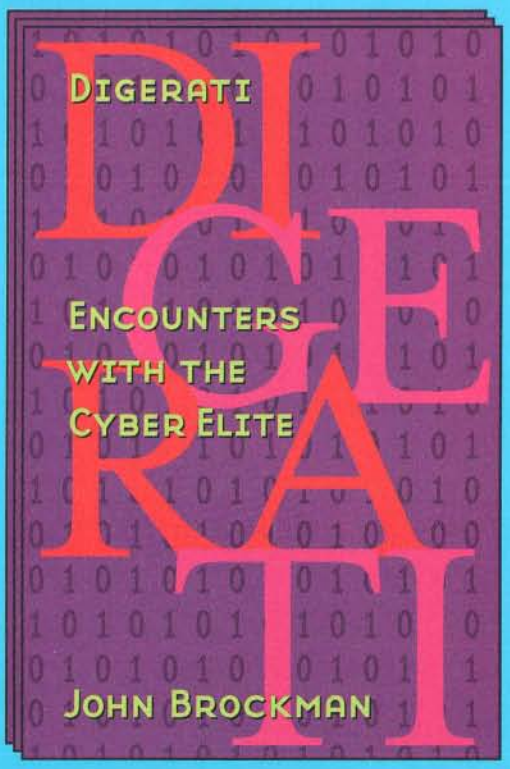
He's right to worry. In recent months, complaints about Gutenberg's use of overtaxed U of I computing resources led to an ultimatum from school officials: find a formal university sponsor or get off. Hart tried the library, the School of Library and Information Science, and a computer network run jointly by the Big 10 football schools. No luck. "The library, which would be the logical place, wasn't interested in sponsoring it - they might have been concerned about the project's academic credentials," says Bob Penka, an associate director at the U of I's Computing and Communication Services office. "Whether that's snootiness or what, I don't know." Hart has lost his U of I email account, but so far the project is getting a stay of execution - at least until the next round of complaints.

Is Gutenberg too important to be left to a solitary eccentric? Maybe it should be organized by the Library of Congress, the National Endowment for the Humanities, or some such organization.

But herein lies another problem. Hart isn't the only one staking out literary dibs in cyberspace. The Georgetown Center for Text and Technology counts more than 300 online library projects in nearly 30 countries, including the Dartmouth Dante Project, with 600 years of commentary on Dante's *Divine Comedy*, and the Oxford Text Initiative, which charges users to download its scholarly publications.

And for all its high-minded goals, Gutenberg's simplicity works against it. It lacks the bells and whistles, the flashy graphics and sophistication that grant-givers love. Instead, Hart plods along in ASCII, doesn't give a hoot about market research, and wants to give his product away.

The lack of recognition rankles. "There



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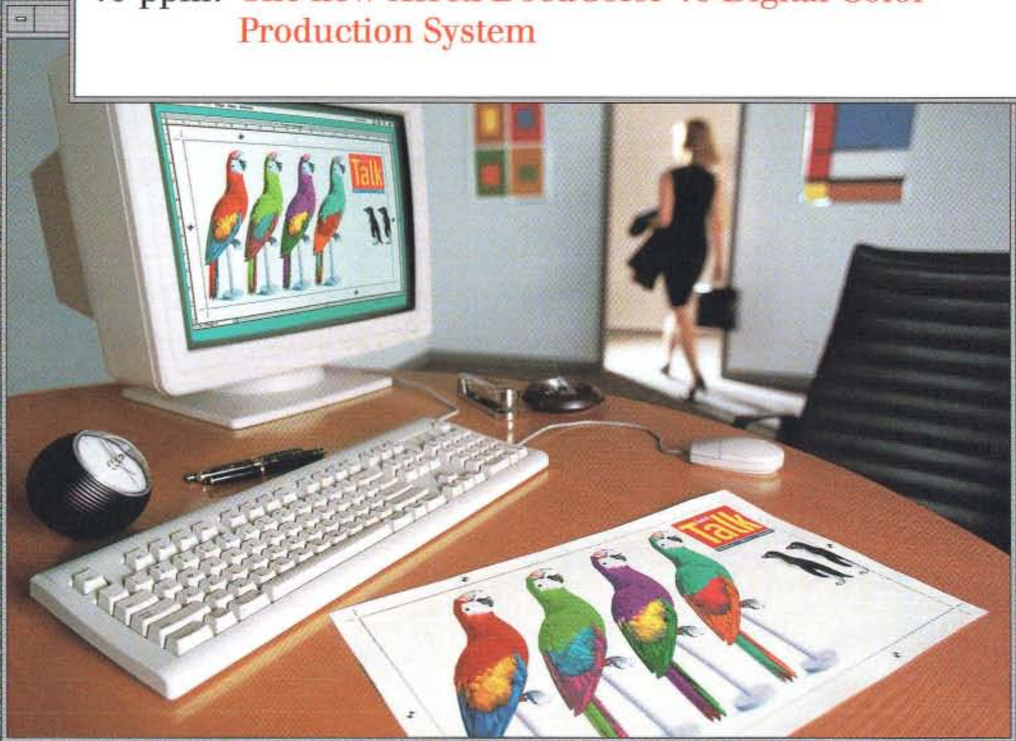

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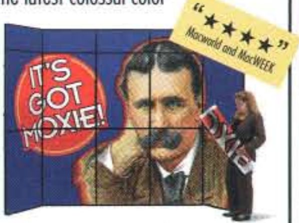

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are literally a billion dollars of grant money out there, and I'm never going to get any of it," he says. And those 300 competitors? "All those projects will never produce even one mainstream book that you or I will ever see."

Digital library experts say he's got a point. "Funders tend to be interested in projects that use state-of-the-art technology or advance knowledge, or that create something new and exciting," says Ann Bishop, a coprincipal investigator with the U of I's Digital Library Initiative project, which is working with commercial publishers to put academic journals online. "Projects that aren't high tech tend to get lost in the shuffle. Perhaps if he played it up as something vital to national education, he would get more funding. But I don't know if he's interested in twisting it that way."

Ultimately, Hart's biggest impediment may be US copyright law, which pretty much prohibits Gutenberg from publishing anything written after 1920. The law now protects a work for 50 years after the author's death, which means that Hemingway, Genet, and Garcia Márquez won't be online anytime soon. Even *The Odyssey* and Plato's *Republic* are off-limits if Gutenberg wants to post a translation published after 1920. One exception is when an author gives special permission, such as cyberpunk author Bruce Sterling, who approached Hart to release an e-text of his novel *Hacker Crackdown*.

The copyright problem isn't getting any easier. The first US copyright law covered 14 years, with a possible 14-year extension. A 1909 amendment doubled that to 28 years, and in 1976, the law was extended again. Now Congress is considering going to life plus *70 years*. "Do you realize that under the proposed law, the blueprint for the Wright Brothers' airplane would still be under patent?" asks an incensed Hart, who has testified in Washington against the new bill's passage. "If they win, we'll have to get a certain number of titles and then quit. Unless we want to do the Robin Hood thing. And I'm too old to be a revolutionary." A glint appears in his eye. "But I'll do *Gone with the Wind* on my deathbed," he vows. "The book and the movie. It *should* be out there."

If Hart were any less obsessed, he would have given up long ago. But without reinforcements, the project probably will stall, and that's a shame.

I leave Urbana feeling that Hart just might meet his short-term goal. If he were any less obsessed, he would have given up a long time ago. Instead, he is doubling each year. But I also wonder how long the project can keep expanding exponentially. Unless Hart can draft reinforcements or hook up with a sponsor, eventually it probably will stall, and that's a shame.

As the plane takes off, I recall Hart's description of the mad rush that comes from sitting in his basement, watching the newly transcribed files come in, working on them, and then launching books into cyberspace. His words echo in my head: "Bennett Cerf never published a book a day, but I'm doing it. Do you have any idea of how powerful that makes me feel? But sometimes I go to bed at night, and I don't know what I'm going to do in the morning because no one's sent me anything. That's kind of scary." ■ ■ ■

Denise Hamilton is an obsessive reader who writes regularly about business and culture for the Los Angeles Times, New Times, *and other publications.*

***Michael Hart and Project Gutenberg can be reached at* hart@pobox.com.**

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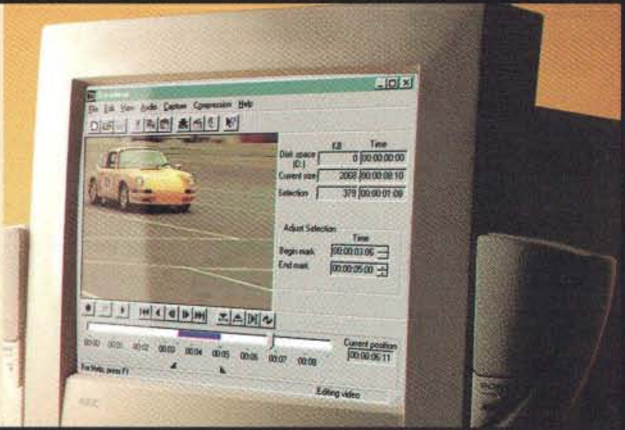

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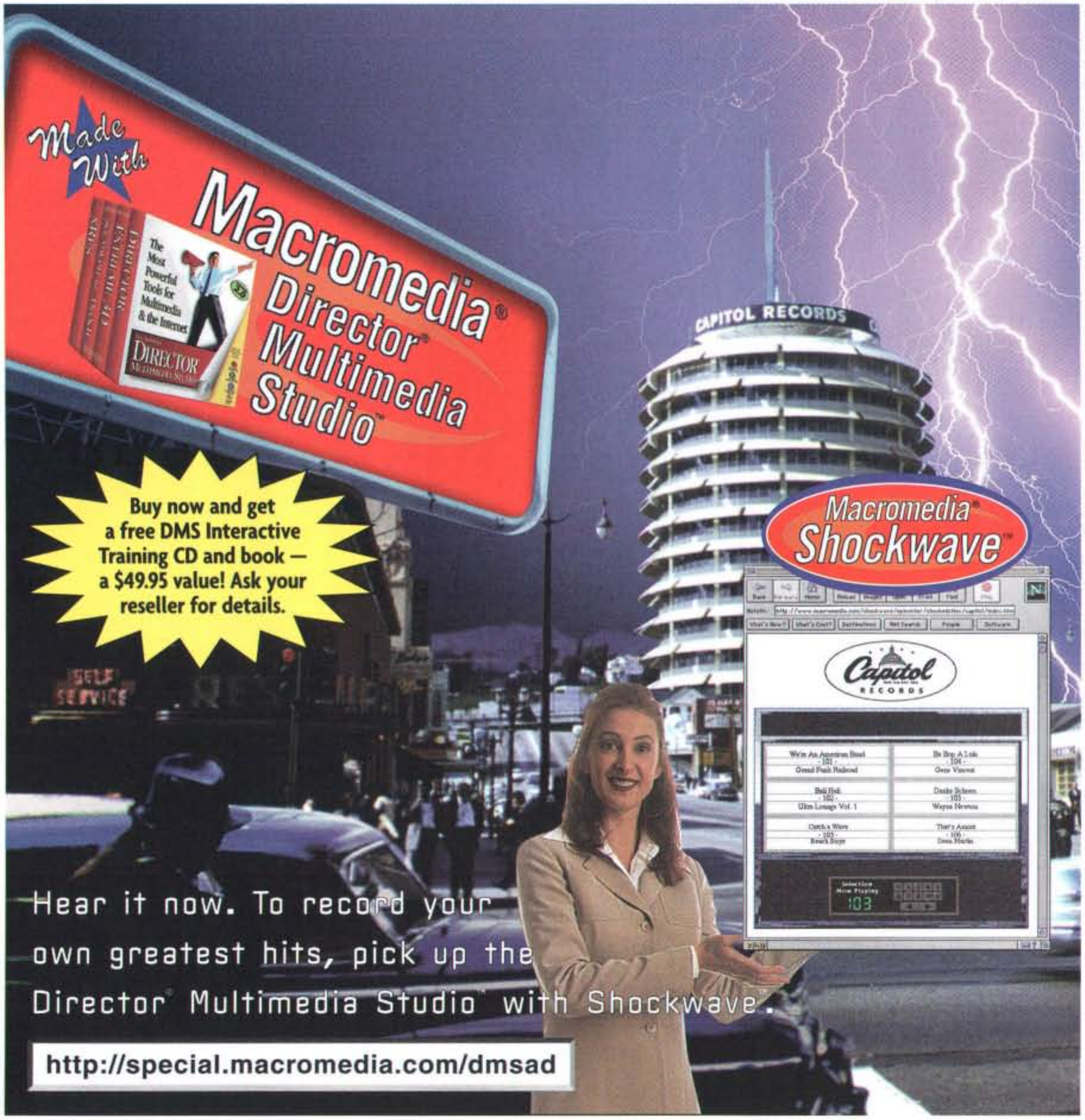
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More Is Less

By David Shenk

he future decides what
ill emerge out of what
xists in the present."
Wolfhart Pannenberg

With the introduction of PointCast, MSNBC, and myriad other instant electronic news services, 1996 turned out to be the best year yet for news junkies. And this is just the beginning. The Internet and telecom deregulation have spawned a news revolution that will make today's flurry of instantaneous news look like a scene from *The Flintstones*. What's good for Ted Turner and Bill Gates isn't all that great for the rest of us, however. In a world glutted with information, constant updates are not only a diminishing asset, they are becoming a dangerous distraction. Watching could be hazardous to our health.

Since the dawn of time, humans have constructed a quilt of community understanding out of *new* information. In a world of information scarcity, messenger-journalists performed the vital community service of acquiring and transmitting fresh data. Newspapers, wrote Arthur Young in 1793, are "that universal circulation of intelligence, which in England transmits the last vibration of feeling or alarm, with electric sensibility, from one end of the Kingdom to another." This sentiment was echoed by Adolph Ochs when he bought *The New York Times* in 1896. Its mission, he declared, was to "give the news, all the news ... and give it as early, if not earlier, than can be learned through any other reliable medium."

Then information came into abundance. Data is now so plentiful that consumers face the curious hazard of information glut. We cannot keep up with the information we produce.

In this context, new information becomes more of a diversion than a contribution to society. Today's challenge is to manage the vast quantities of information we already have stored up. News is not, of course, completely irrelevant. But the value of daily updates will pale in comparison to information we already have on hand – how to feed and clothe ourselves, fight pestilence, and govern ourselves using a balance of strict laws and broad liberties. The new challenge is to share this information with each other, to manage it thoughtfully, and to transform it into knowledge inside millions of individual brains. This is not so much fact-hunting as it is data-gardening.

The traditional news media haven't come to terms with this fundamental shift, which is why Yahoo!, AltaVista, and other Web libraries are fast becoming primary information sources. Yet old-school journalists maintain a fierce bias against what they call *old news*. "We've *covered* that," they snarl. "It's been done." They opt instead for anything that smells new or dramatic – divorces, disgraces, deaths. "My job is not to educate the public," insists TV producer Steve Friedman in a typically myopic declaration of journalistic principle. "My job is to tell the public what's going on." His distinction is criti-

NC: New Centralism?

By Russ Mitchell

Will the network computer succeed? "In some Nazi-oriented companies it will succeed very well," says Michael Dertouzos, head of computer science at MIT. Yanking expensive PCs and replacing them with cheap NCs will save companies a lot of money. But the cost to innovation will be high.

It's no coincidence that the breakdown in rigid corporate hierarchies and the addition of employee "empowerment" to the management lexicon paralleled the move from mainframes to PCs. With PCs, employees gained more control over their work. And because they could customize the computers, new software that may never have received the approval of MIS managers entered the workplace.

All computers can be networked, of course. But the PC is a smart machine. The NC is a dumb terminal. A network of dumb terminals adds up to a dumb organization.

Russ Mitchell (russ@wired.com) *is managing editor at* Wired.

Does Not Compute

By Isabel Walcott

By and large, educators still think of computers as inherently mathematical. Most high schools present computing as part of the math-science curriculum. Meanwhile, professionals create programs without even using computer code; users create documents and programs using drag-and-drop icons or pulldown menus. Saying you need to be good at math to use a computer is like saying you need to be an architect to live in a house.

A paradigm shift, not money, is the operative need. Teachers need to educate themselves about computers. Computers need to be brought out of math ghettos. Without being introduced to the range of possibilities, students are missing out on what they could be learning. As a result, neither computers nor people can reach their full potential. The *compute* in *computer* denotes only how the device works, not how we work with it.

Isabel Walcott, a multimedia entrepreneur, is designing a major Web site for teenage girls (www.smartgirl.com/).

"Information isn't always power – just ask a librarian."
– *David Brake*

cal. Mere *telling* focuses on the mechanics of transmitting news of the moment, while education assumes a responsibility for making sure that knowledge sticks. Journalists who limit their role to news flashes are absolving themselves of any overarching obligation to the audience.

In our new world, reporters must become more like teachers, and we all must learn the skills of the librarian. Information management is the fuel for our thriving civilization. But in the last 50 years, the integrity of our data management has been threatened by a historical first: production is now dramatically outpacing consumption. This leaves us with what Finnish sociologist Jaako Lehtonen calls an "information discrepancy," a permanent processing deficit. "The real issue for future technology," says Eli Noam, the director of Columbia University's Institute for Tele-Information, "does not appear to be production of information, and certainly not transmission, but rather processing. Almost anybody can *add* information. The difficult question is how to *reduce* it."

If we can't find a way, Noam warns, we may be setting ourselves on a road toward a chaos that not even scientists will enjoy observing. The organization of information, says Noam, is the one major counterforce to entropy. Not being able to effectively manage our information means that we may be beginning to lose control of information and finally succumbing to entropy. In this light, an increasingly news-manic culture is not only less and less attuned to its own needs, but may also be on a track to oblivion. Now *that's* devolution.

David Shenk (dshenk@aol.com) *writes the "Net Skeptic" column for MSN. His book,* Data Smog: Surviving the Information Glut, *will be published in April by HarperCollins.*

"The pleasures of wealth and greatness … strike the imagination as something grand and beautiful and noble, of which the attainment is well worth all the toil and anxiety which we are so apt to bestow upon it. And it is well that nature imposes upon us in this manner. It is this deception which rouses and keeps in continual motion the industry of mankind."
– *Adam Smith*

Scorning Privacy

By Rebecca Eisenberg

Who cares about Internet privacy; try complete disclosure. Confoundingly, many who argue for a marketplace of ideas and a free-market economy also argue for secrecy, privacy, and NDAs.

The exchange of information is one of the best ways to foster progress. Yet thanks to corporate firewalls, many keep things private against their will, out of obligation to another person. That other person often demands privacy to avoid social ridicule if the information got out or – possibly more often – because business would suffer if someone else were to "steal ideas."

But if all ideas were shared, there could be no IP theft. And if more people dared to be honest about their behavior, then little could cause social scorn.

Rebecca Eisenberg (rebecca@cyborganic.net) *is a freelance writer who lives at* www.cyborganic.com/people/rebecca/.

Give Workers a Free Choice

By José Piñera

More young Americans believe in UFOs than believe they will receive a Social Security check when they retire. Among other things, this is a terrible indictment of a government program that has run its course.

When Otto von Bismarck created pay-as-you-go social security in 1883, he never dreamed that most governments in the Western world would adopt his model – and that a century later all those systems would be heading toward bankruptcy. The absurdity of the pay-as-you-go system is comparable to that found in the works of Franz Kafka, whose days working at a social security institution must have been a source of inspiration. Suffice it to say that all over the world, social security administrators must be having nightmares about biotech breakthroughs like DHEA that may allow more and more people to celebrate their 100th birthday. In a way, these are also nightmares about a sort of metamorphosis, though not into giant insects.

The system could survive longer if people had more babies, since younger generations finance the pensions of the old. But the opposite is occurring in all rich countries – including the United States.

I come from a distant country, one the Spanish conquerors initially named *Finis Terrae* (Land's End). But in these days of a global village,

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– *C. Vann Woodward*

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I can bring you an idea, a powerful idea, that can save social security by privatizing its provision. We tried this idea in Chile 16 years ago. (See "Empowering Workers: The Privatization of Social Security in Chile" at *www.socialsecurity.org/*.) At age 30, I became minister of labor and social security in Chile and, with a team of young and creative people that I assembled to devise the reform, we did not ask "Why?" but rather, as Bobby Kennedy had urged, "Why not?"

Indeed, why not the best social security system for all workers? Not only for the ones with the extra cash to buy private retirement insurance, but also for those who could not afford to save because of onerous taxes. We came up with a simple idea: allow each worker to put their payroll tax into an individual pension savings account (PSA), where they could keep an eye on their money (or, as we say in Spanish, *"la plata donde mis ojos la vean"*). These funds would be invested in real wealth-producing activities; of course, not all the eggs would be put in the same basket. And so workers would have capital of their own when they retire. The entire system would be managed by private enterprises in a highly competitive market (no barriers to entry, no initial advantages to established banks or financial institutions). The PSAs would be portable so workers could move them to another company.

Perhaps the most difficult task was to devise a workable transition to the new system. We set three rules: "Do not hurt your grandmother" (guaranteeing benefits to those already retired); "Give workers a free choice" (offering the option of staying in pay-as-you-go or opting out voluntarily); and "Do not accumulate more debt for your grandchildren" (closing the door of pay-as-you-go for young new entrants). We also devised responsible ways of financing that sunk cost without increasing tax rates.

The results? Today 9 out of 10 workers are in the PSA system. They have received an average return rate of 12 percent above inflation during 15 years. The whole issue has been depoliticized and civil society strengthened. The economy, not surprisingly, has also benefited: more savings (Chile has a savings rate of 27 percent of GNP), higher productivity of capital (invested through markets), and more employment since the tax on the use of labor has been eliminated (the unemployment rate is 5.5 percent). Ultimately, higher growth and more opportunities for everyone.

Joe Klein – although not anonymously – came to Chile in 1994 to see whether all this was true. Upon his return to the United States, he wrote an article titled "If Chile Can Do It …" for *Newsweek*. "The Chilean system," he wrote, "is perhaps the first social policy idea to emanate from the Southern Hemisphere." If my eldest son, born in Boston and carrying an American passport, comes to work here in the future, perhaps he will be able to transfer his pension fund from a Chilean PSA to an American PSA.

José Piñera is president of the Santiago-based International Center for Pension Reform and cochair of the Cato Institute Project on Social Security Privatization in Washington, DC.

"The only thing more frightening than a programmer with a screwdriver or a hardware engineer with a program is a user with a pair of wire cutters and the root password."
– *Elizabeth Zwicky*

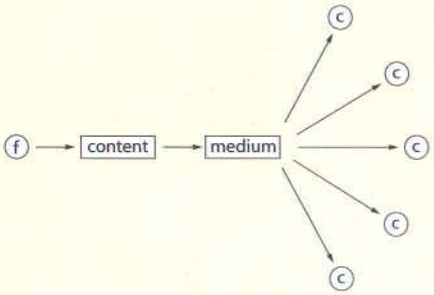
In Praise of Inaccuracy

By Nick O'Donohoe

History, like capital, is valued for its liquidity; most cherished myths are freely sculpted truth. For nobility, for nostalgia, for comfort and confirmation, we turn not to a verifiable recording of the past, but to a loose rendering of it. That fuzziness is our heritage, the other merely a record of what happened. Yet the progression from print to photography to video has preserved more and more events from the past, more and more accurately. With digital storage, we may offer posterity our closest effort yet to a point-for-point correspondence between the event experienced and the record examined. Fortunately, people don't observe events carefully, don't confirm facts diligently, and don't remember or repeat information accurately. Analog rumor will still work around digital truth, and we will retain that comfortably slippery sense of reality that grants us possession of history.

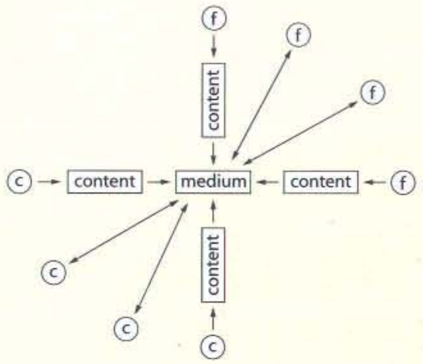
***Nick O'Donohoe* (nicholasod@aol.com) *is an author whose fantasy novels include* The Magic and the Healing.**

Before & After



In one-to-many media (above), the firm (f) transmits a stream of content through a medium to consumers (c). Compare the many-to-many hypermedia environment below.

***Source: "Marketing in Hypermedia Computer-Mediated Environments: Conceptual Foundations," by Donna L. Hoffman and Thomas P. Novak, Journal of Marketing, Volume 60, July (1996): 50-68* (www2000.ogsm.vanderbilt.edu/cmepaper.revision.july11.1995/cmepaper.html).**



"If I'm going to have a past, I prefer it to be multiple choice."
– *The Joker*

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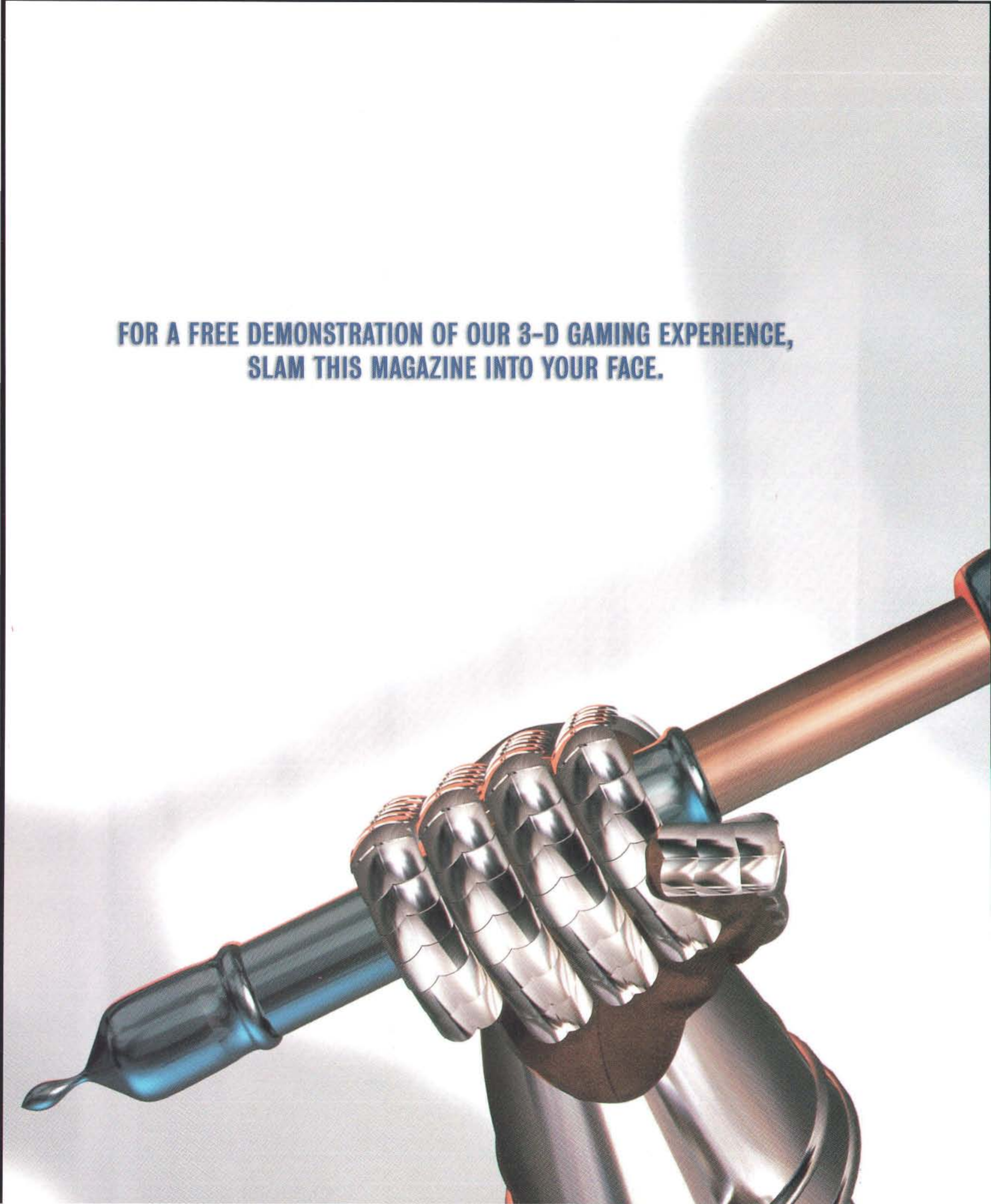
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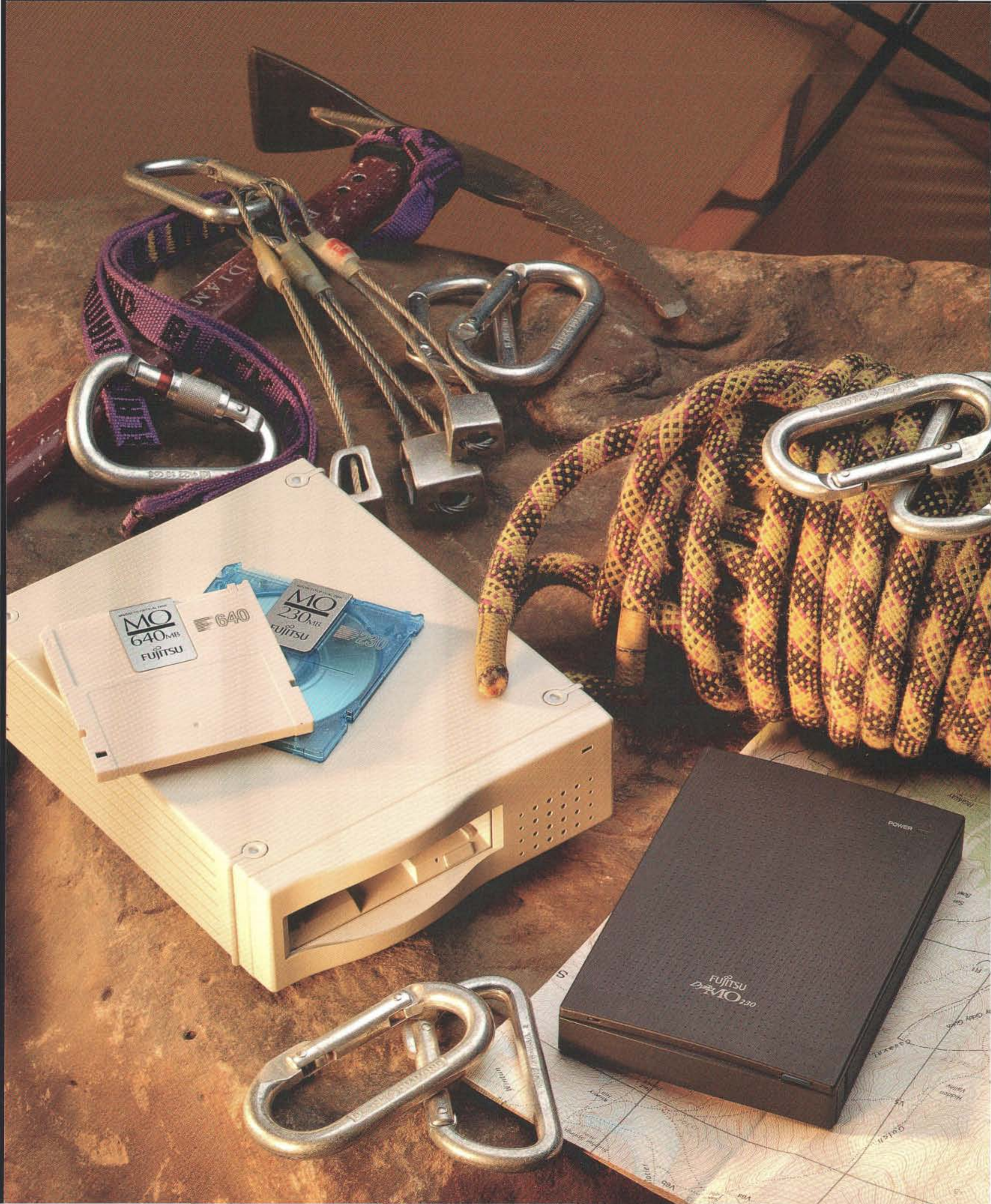
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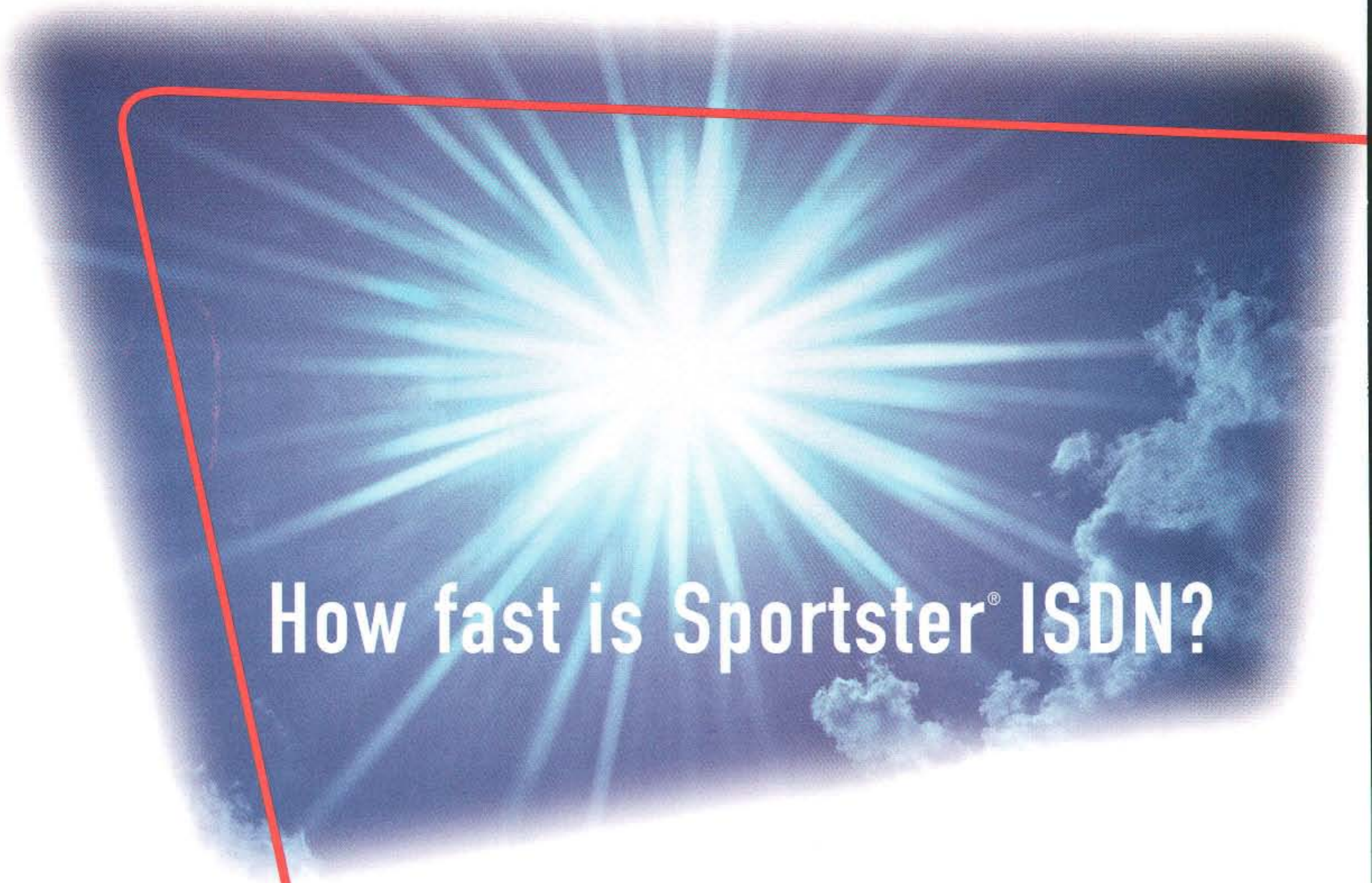

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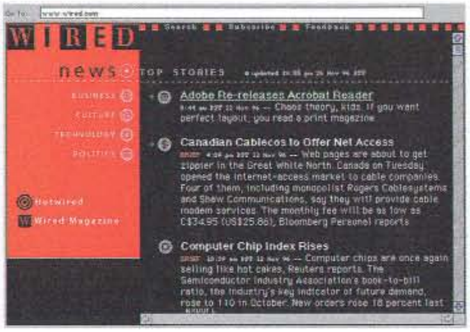

Adobe Re-releases Acrobat Reader

— Chaos theory, kids. If you want perfect layout, you read a print magazine.

Canadian Cablecos to Offer Net Access

— Web pages are about to get zippier in the Great White North. Canada on Tuesday opened the internet-access market to cable companies. Four of them, including monopolist Rogers Cablesystems and Shaw Communications, say they will provide cable modem services. The monthly fee will be as low as C$34.95 (US$25.86), Bloomberg Personal reports.

Computer Chip Index Rises

— Computer chips are once again selling like hot cakes, Reuters reports. The Semiconductor Industry Association's book-to-bill ratio, the industry's key indicator of future demand, rose to 110 in October. New orders rose 18 percent last

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THE ENVIRONMENT IS GOING TO HELL, AND HUMAN LIFE IS DOOMED TO ONLY GET WORSE, RIGHT? WRONG. CONVENTIONAL WISDOM, PLEASE MEET JULIAN SIMON, *the* DOOMSLAYER

BY ED REGIS

PHOTOGRAPH BY NEIL SELKIRK

www.wired.com/5.02/simon/

This is The litany: Our resources are running out. The air is bad, the water worse. The planet's species are dying off – more exactly, we're killing them – at the staggering rate of 100,000 per year, a figure that works out to almost 2,000 species per week, 300 per day, 10 per hour, another dead species every six minutes. We're trashing the planet, washing away the topsoil, paving over our farmlands, systematically deforesting our wildernesses, decimating the biota, and ultimately killing ourselves.

The world is getting progressively poorer, and it's all because of population, or more precisely, *over*-population. There's a finite store of resources on our pale blue dot, spaceship Earth, our small and fragile tiny planet, and we're fast approaching its ultimate carrying capacity. The limits to growth are finally upon us, and we're living on borrowed time. The laws of population growth are inexorable. Unless we act decisively, the final result is written in stone: mass poverty, famine, starvation, and death.

Time is short, and we have to act *now*.

That's the standard and canonical litany. It's been drilled into our heads so far and so forcefully that to hear it yet once more is … well, it's almost reassuring. It's comforting, oddly consoling – at least we're face to face with the enemies: consumption, population, mindless growth. And we know the solution: cut back, contract, make do with less. "Live simply so that others may simply live."

There's just one problem with The Litany, just one slight little wee imperfection: every item in that dim and dreary recitation, each and every last claim, is false. Incorrect. At variance with the truth.

Not the way it is, folks.

PERCEPTION	REALITY
 The Third World is running out of food.	 **Food supplies per person in developing countries are up 25 percent since 1960.**
 Sprawl is paving over vital cropland.	 **Farmland currently lying fallow in the US and Argentina alone could feed an additional 1.4 billion people.**
 Air pollution is getting worse.	 **Since 1970, total number of particulates in the air over the US has dropped by two-thirds.**
 We are running out of oil.	 **From 1980 to 1990, known crude oil reserves increased by 50 percent.**

Thus saith The Doomslayer, one Julian L. Simon, a neither shy nor retiring nor particularly mild-mannered professor of business administration at a middling eastern-seaboard state university. Simon paints a somewhat different picture of the human condition circa 1997.

"Our species is better off in just about every measurable material way," he says. "Just about every important long-run measure of human material welfare shows improvement over the decades and centuries, in the United States and the rest of the world. Raw materials - all of them - have become less scarce rather than more. The air in the US and in other rich countries is irrefutably safer to breathe. Water cleanliness has improved. The environment is increasingly healthy, with every prospect that this trend will continue.

"Fear is rampant about rapid rates of species extinction," he continues, "but the fear has little or no basis. The highest rate of observed extinction, though certainly more have gone extinct unobserved, is one species per year ..."

(One species per year!)

"... in contrast to the 40,000 per year that some ecologists have been forecasting for the year 2000.

"The scare that farmlands are blowing and washing away is a fraud upon the public. The aggregate data on the condition of farmland and the rate of erosion do not support the concern about soil erosion. The data suggest that the condition of cropland has been improving rather than worsening."

A world of scarcity or abundance? As an acid test, Simon's 1980 wager with Paul Ehrlich could hardly have been more elegant: pick five basic commodities. Wait 10 years. See whether prices rise or fall.

Catastrophist Ehrlich lost.

As for global deforestation, "the world is *not* being deforested; it is being reforested in general."

Still, there *is* one resource that the world does not have enough of, that's actually getting rarer, according to Julian Simon. That resource: people.

"People are becoming more scarce," he says, "even though there are more of us."

Hello?

Simon started off as a card-carrying antigrowth, antipopulation zealot. He'd been won over by the conventional reasoning; he regarded the central argument as absolutely persuasive. And indeed, if we rehearse it now, it sounds like a faultless proof, clear and compelling, even watertight.

The classical case against population growth was expressed in 1798 by Thomas Malthus, the British economist and country

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Ed Regis (edregis@aol.com) *is the author of* Virus Ground Zero, *about the 1995 Ebola outbreak in Kikwit, Zaire.*

FAMINE: LIZ GILBERT/SYGMA; MARKET: SUPERSTOCK; FARM: SUPERSTOCK; LA SMOGGY: MARK STEPHENSON/WESTLIGHT; LA CLEAR: ROBERT LANDAU/WESTLIGHT; OIL: PETER KAEHLER/IMAGE BANK

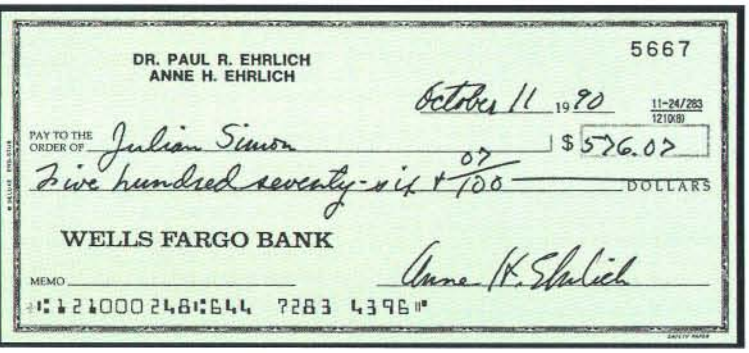
parson who wrote in *An Essay on the Principle of Population*: "Population, when unchecked, increases in a geometrical ratio. Subsistence increases only in an arithmetical ratio. A slight acquaintance with numbers will show the immensity of the first power in comparison of the second."

As a point of abstract mathematics, there is no way around the conclusion that a geometric progression, if carried on far enough, will eventually overtake an arithmetic progression, no matter what. If population increases geometrically while "subsistence," or food, increases arithmetically, then sooner or later the population will run out of food. End of story.

Or so it would appear, except for the following embarrassing fact:

"Population has never increased geometrically," says Simon. "It increases at all kinds of different rates historically, but however fast it increases, food increases at least as fast, if not faster. In other words, whatever the rate of population growth is, the food supply increases at an even faster rate."

These, he says, are the actual and empirical facts of the matter, information available to any inquirer. Simon first got a taste of those facts while studying the data amassed by the economic demographer Simon Kuznets (winner of the 1971 Nobel Prize in economics) and by economist Richard Easterlin, in the mid-1960s. Kuznets had followed population growth trends that went back 100 years and compared them against standard of living, while Easterlin analyzed the same data for selected countries since World War II. The studies showed that while population growth rates varied from country to country and from year to year, there was no general negative correlation with living standards. People did not become poorer as the population expanded; rather, as their numbers multiplied, they produced what they needed to support themselves, and they prospered.



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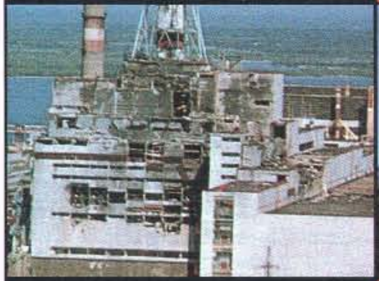
The trends were the same for food supply. Rising population did *not* mean less food, just the opposite: instead of skyrocketing as predicted by the Malthusian theory, food prices, relative to wages, had *declined* historically. In the United States, for example, between 1800 and 1980, the price of wheat plummeted while the population grew from 5 million to 226 million. According to Malthus, all those people should have been long dead, the country reduced to a handful of fur trappers on the brink of starvation. In fact, there was a booming and flourishing populace, one that was better-fed, taller, healthier, more disease-free, with far less infant mortality and longer life expectancy than ever before in human history. Obesity, not starvation, was the major American food problem in 1980. Those were the facts.

PERCEPTION	REALITY
 Soil erosion will lead to new dust bowls.	 **Since the 1950s, the percentage of US cropland losing soil through erosion has dropped by more than two-thirds.**
 The forests are vanishing.	 **Though tropical forests remain imperiled, in temperate regions forests are expanding.**
 **Nuclear power is too dangerous.**	 **Generating all US electricity with nukes would have the risk equivalent of raising the national highway speed limit 0.006 mph.**
 The world's oceans are being "fished out."	 **Seafood production could be tripled on a sustained basis.**

Source: *The State of Humanity*, 1995

CORNFIELD: PATTY MCCONVILLE/IMAGE BANK; FOREST: HANS WENDLER/IMAGE BANK; CHERNOBYL: SYGMA; FISH HEAD: SUPERSTOCK; FISH MARKET: LOU JONES/IMAGE BANK

Nor should they have come as any great surprise, once you gave the matter some thought. Plants and animals used for food constitute "populations" just as human beings do, and so they, too, ought to increase not arithmetically, as Malthus claimed, but geometrically. The food supply, in other words, ought to keep pace with human population growth, thereby leaving all of us well-fed, happy, and snug in our beds.

Which, Simon discovered, is exactly what has happened throughout history. So if you look at the facts - as opposed to spinning out theories - you find precisely the reverse of the situation described by Malthus. Just the opposite!

Simon acquired his habit of looking up the facts in early childhood, at the dinner table of the family home in Newark, New Jersey. He'd be in some argument with his father over the benefits of exercise, the price of butter, or the health value of air conditioning, and whether from ignorance, pigheadedness, or general perversity, his father would always take some outlandish, off-the-wall viewpoint, such as: "The price of butter is 8 cents a pound."

Julian: "No, it's not, it's 80 cents a pound. It's in the newspaper, take a look."

Father: "I don't have to look. I *know* it's 8 cents a pound."

Julian: "Do you want to bet? I'll *bet* you it's not 8 cents a pound."

His father would never take the bet, but Julian would go to the library anyway, look things up in books, and come back with a ream of facts and data. His father, however, couldn't care less.

"I clearly didn't like my father," says Simon.

It's an attitude that drives him crazy to this day - people who know in advance what the truth is, who don't need to avail themselves of any "facts." But Simon loves facts and figures, he loves tables, charts, graphs, information arranged in rows and columns. Tabulations, the slopes of curves, diagrams, pie charts, histograms - he's a regular Mr. Data.

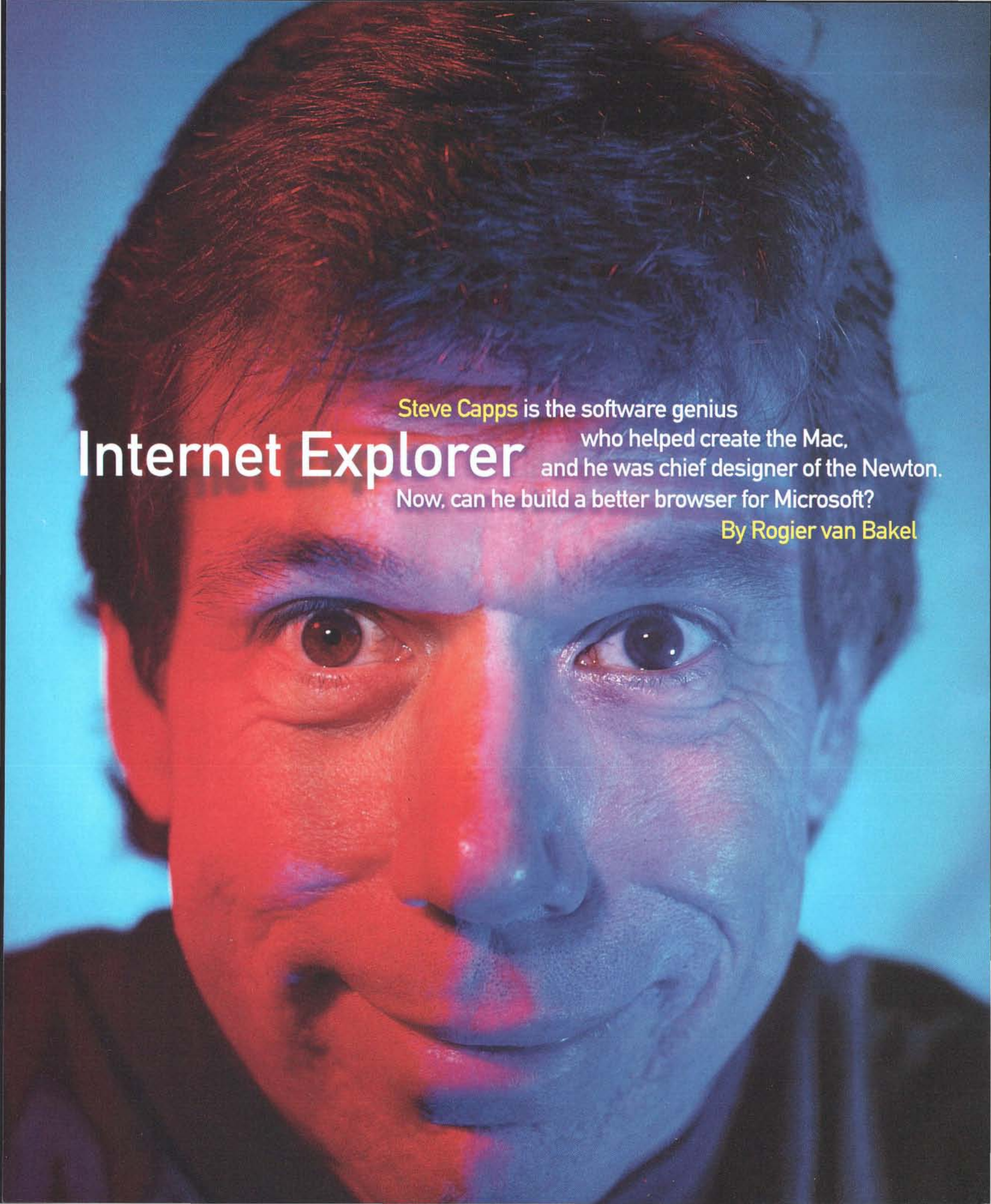
Of course, since people don't particularly like to have their cherished beliefs contradicted by heaps of facts served up on a platter, Simon has never been

193 ►

Hyperreal

For years, the digital age proved a sorry toolmaker for envisioning unbuilt architecture. Wimpy wire frames or cartoonish mock-ups required a healthy imaginative leap to seem like places you'd want to live or work. But a new wave of "hyperrealistic" computer renderings skillfully blends traditional drawings with photography to eliminate this shortfall. The trompe l'oeil styling by Rafael Viñoly Architects, for instance, evoked the airy openness of the Tokyo International Forum (right) months before a single pane twinkled in the seven-story lobby. – *James Daly*

***James Daly is a features editor at* Wired.**



Internet Explorer

Steve Capps is the software genius who helped create the Mac, and he was chief designer of the Newton. Now, can he build a better browser for Microsoft?

By Rogier van Bakel

Wired: You defector, you!

Capps: Well, it's 1996, not 1986. Get with the program. When Apple and its fans still go around moping, "The other guys stole our ideas," it gets a little juvenile. It's all shoulda-coulda-woulda. Yes, Windows was strongly inspired by the Mac OS. I just don't think that's such a big deal. We did a great job at Apple in 1984; then we rested on our laurels and did nothing for years. Microsoft seized the moment. When I left Apple, I wanted to get involved with the Web, because that's increasingly how people interact with their computers. There are very few moments in history where you can help change user paradigms. The Mac desktop experience was one; I wanted to create another like it. My choices were to go work for Netscape or Microsoft. And Microsoft is much hungrier. Netscape is saying, "It's good enough." They're like Apple 10 years ago. They have instantly fossilized their thinking.

Why do you feel the current generation of browsers isn't good enough?

Web sites are becoming as complex as applications. It's just not that easy to write application GUIs, so guess who suffers? The user. Each site is different. You have to learn that on this site the buttons work one way, and on another site the index is stored here, and so on. Everybody's partaking in this great Internet land rush, so civilities like consistency, usability, and reliability are tossed aside. We're going to have to get used to chaos.

Which you will eventually tame.

Look, sites don't work well with browsers and vice versa. There could be a lot of synergy that isn't being developed. For instance, instead of every site having an incompatible concept of a directory, there should be a standard one that the browser places in a familiar spot. That way, users can always come back to the touchstone to get their bearings. We should take some of the complexity out of the process without taking away Web designers' toolkits. I was at a conference where this guy from U S West told us how they tested the GUI on their Web site. The site was an internal one that served as the employees' handbook. They started with a "modern" graphic design, then went to a cuter eWorld clone. They ended up with a vanilla text-based one. So, real users don't necessarily like what webmasters are throwing at them. Yes, the Web is exciting because every time you go to HotWired it's different. But when you want to look up an article you forgot to read on your last visit and suddenly you can't find it anymore, the charm is lost. I know it's hard for the George Clooney-haircut/art-school crowd to believe, but they really should think before they kill this golden goose.

Rogier van Bakel (www.li.com/rogier/) *is a contributing editor at* Wired.

The Newton never became as ubiquitous as Apple hoped. Do you think the Pilot PDA, developed by U.S. Robotics, will fare better?

But the Pilot is not a platform. It just quietly and stupidly talks to existing desktop applications. It's really a terrible GUI, just one step above DOS. It doesn't do email. You can't even draw graphics on a Pilot. I think they've done a good piece of work, but then you look a little closer and say, "OK, you've solved the hard problem, which is synchronization with the desktop; why didn't you spend an extra five days, or five hours, cleaning up your GUI?" But what do you want from a modem company, right? They think that a GUI is a bunch of blinking LEDs.

My Newton 130 didn't have email built in, and it doesn't have a browser. That seems strange, seeing how important the Internet has become.

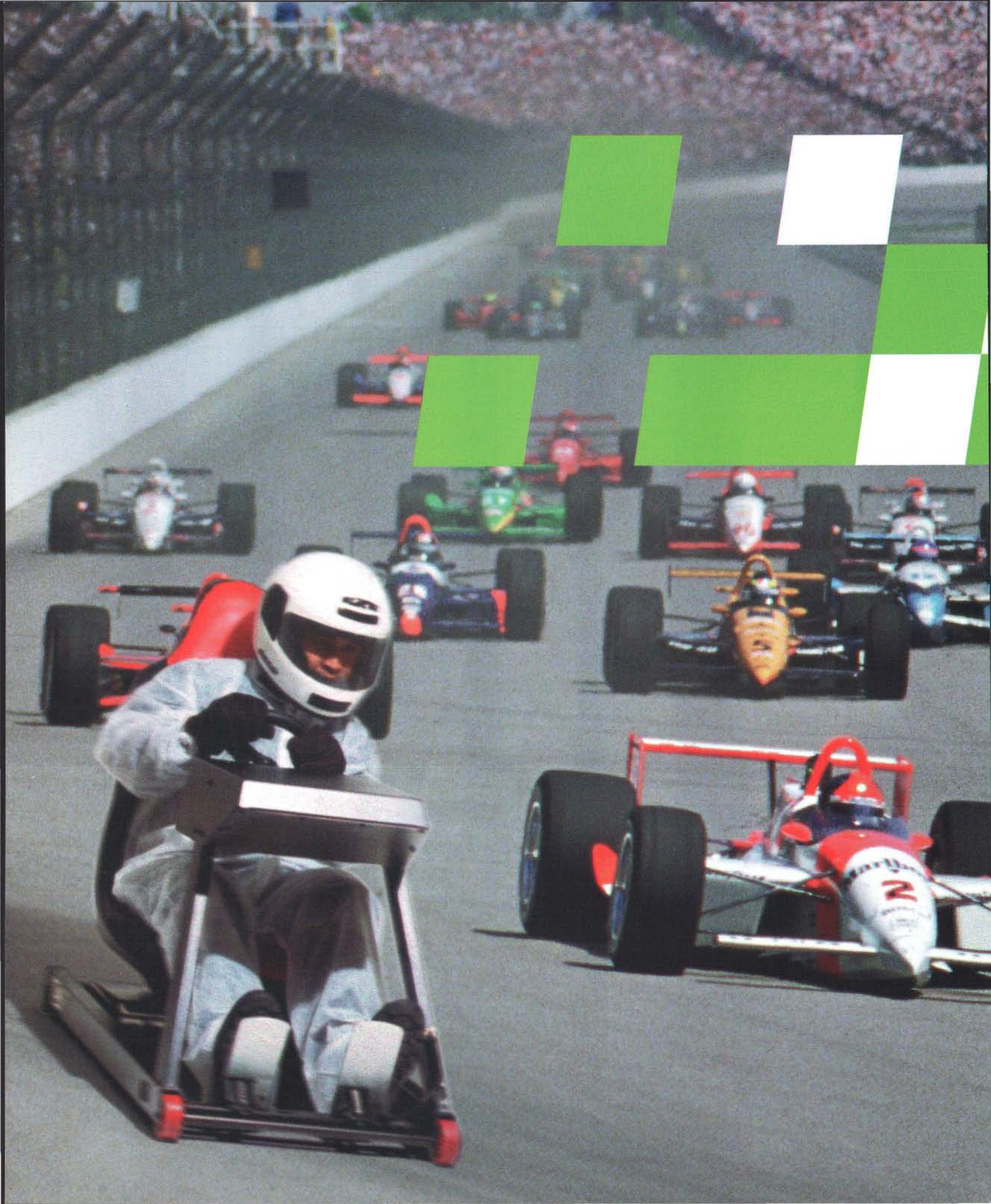
Well, it had an email program, but unfortunately, it was connected to a dead service [Apple's ill-fated eWorld]. You can get third-party browsers now, but the results are a little flawed. The Web thrives thanks to things like Pentium chips, large color screens, and Shockwave. It's very hard to take content that was designed for a 640-by-480, 8-bit display and cram it into a 300-by-200-pixel black-and-white display. Which is not to say that there aren't interesting things to be done there. By virtue of the fact that HTML is display-size independent, you can actually do something useful. But the Newton was just not designed to be an Internet cruiser. It was never meant to replace your desktop PC; it was supposed to be a satellite. The Web is really a desktop story. Shockwave and Java – look at the size of those programs! Sure you can put that into a handheld device, but then it would cost two or three thousand dollars.

When Steve Capps moved to Microsoft last year it raised eyebrows in Silicon Valley and caused consternation among Mac diehards everywhere. Capps going to work for Bill Gates?! The same Capps who was a key software developer on the original Macintosh team and the chief designer of Apple's Newton? A genius of the graphical user interface, Capps hasn't lost his passion for PDAs. But now he's really bent on making it easier to navigate the Web.

So let's concentrate on the simple stuff: email. What needs to be done for PDAs to become truly useful email machines?

We have to build in a level of intelligence so the device filters out unwanted messages. Half my mail is what the press is saying about some product. I don't want to read that on a 3-by-5-inch screen. But if I get a message from my boss, yeah, I want to see that. Something that both Apple and Microsoft are playing with is taking the email and doing some processing on it, so it creates a summary that can be sent to your pager or PDA. Based on the summary you can decide if you want to read the original message. That's the first order of business: a smart back end that doesn't bother you with all those stupid press releases. ■ ■ ■

PHOTO: KLAUS SCHÖNWEISE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HARD DRIVE

www.wired.com/5.02/racing/

The parallel universe of auto racing simulation is about to collide with reality.

By Rob Riddell

ORIGINAL PHOTO: TOM LYNN/ *SPORTS ILLUSTRATED*; IMAGE: SANJAY KOTHARI

If you've driven a car, you've probably driven a car irresponsibly. It's blessed hard to resist, isn't it? That what-the-hell, it's-three-in-the-morning high-speed sprint down a familiar stretch of highway, that gratuitous high-g U-turn, that impromptu drag with some guy next to you at a red light who thinks he's hot shit in a Z-car.

Why is reckless driving so fun?

Natural selection, probably. Back in the humbler stages of human evolution, when large predators and serious aggression were part of daily life, being able to blow the scene at speed was a survival trait. So was being able to chase down fast, furry food items. Natural selection favors quickness, simple as that.

Here's how Nature insures that we do, too: by making thinking and moving fast an exhilarating experience. So what happens when you strap your central nervous system into a machine that takes you much, much faster than you were designed to go? Answer: It feels good. Very good.

Auto racing builds on that. It takes the already heady mixture of speed and power and stirs in two more surefire, primal thrills: fierce competition and deadly danger. Racing mainlines to your brain stem. It is probably the most popular sport in the world – and no wonder. After all, driving is more than just a spectator sport. In a very real sense, hundreds of millions of us race every time we get behind the wheel and step on the gas.

But there's a limit to what your disposable income and certain spoilsport law enforcement agencies will allow you to do with your Honda on the streets. Really fast and competitive irresponsible driving is far too expensive and dangerous for all but an élite corps of steely-eyed, flame-suited men. Until now, the rest of us have had to be content merely to watch them. Or race in our heads. At 3 a.m.

Thank god those days are over.

Wanna race? Nowadays, all you need is time, dedication, and, preferably, a 3-D accelerator card.

San Francisco's Pier 39 just about defines the term "tourist hell." When I pull up and find myself surrounded by cutesy overpriced eateries, quasi-historical kitsch, and betacam-wielding Europeans, my instinct is to flee. So I do – right to the video arcade.

Fortunately, I'm not here for food, souvenirs, or any form of human interaction. I'm here to spend a shitload of quarters.

Game designers are clever. They took one look at the legions of twitching teenagers feeding their allowances to *PacMan* and *Space Invaders*, realized that half of them don't yet have driver's licenses, and flooded the market with auto racing games. If you haven't tried or at least seen *Pole Position*, *Sega Rally*, *Indy 500*, or *Crus'n USA*, you haven't been in an arcade since the Reagan administration – the first one.

For me it's been a few years, so I haven't tried half the games at Pier 39. This doesn't matter. They're not complicated: you choose automatic or manual, highlight one of three or four racecourses, and try to go around it really fast. Within about a minute, I've got a death grip on a plastic steering wheel, dilated pupils, and adrenaline coursing through my veins. Damn, but these graphics are *good*!

I wander around on shaky legs, sitting at every racing game I see. There are lots. Some of them are paired together so two people can race side by side: your opponent's car interacts with yours, you can see both cars on both screens, and a big lighted sign flashes "Race Leader" over whoever's ahead.

I find a version of Namco's *Ridge Racer* that takes four quarters a shot, in return for which it offers three-screen reality. This is a slightly more involving experience. It is nothing, however, compared with what I discover a few minutes later: for nine quarters – US$2.25 – you can sit in an actual Mazda Miata, grab its leather-wrapped steering wheel, and hurl yourself down a winding highway at comically unsafe speeds. Only this time, the experience is big: the car faces a curving rear-projection screen about 5 feet high and 25 feet wide.

These graphics are large and real enough to induce nausea and panic. I'm stomping on the brake, leaning into curves, and massively oversteering within seconds of the green flag. The pounding surround-sound music doesn't help my concentration, nor does the incessant recorded voice yelling "Hey! Somebody's right on your tail!" If you're competent, the experience lasts about three minutes. If you're the hapless Italian boy I watched choose the "expert" level by accident and then crash at every opportunity, your nine quarters buy you 45 seconds.

I emerge after three sessions, shaken but not stirred. And I realize that the producer's strategy backfired: When I'm sitting in a real car, gripping a real steering wheel, my mind and body expect real handling, real control. But I don't have them. My brake is flaccid, the steering wheel offers no resistance, the clutch doesn't do anything – in general the car I see on the screen feels only remotely connected to me. The racecourse is, to put it gently, improbable. And the experience is too brief to allow me to get a feel for what I can do.

The ferry across San Francisco Bay, which I put myself on immediately after pumping the last of my quarters into Pier 39's infernal machines, is an exercise in self-control. I'm twitching with residual adrenaline. Scenery is failing to rush by at acceptable speeds! I have involuntary fantasies of storming the bridge and forcing the captain to make it go *fast*, dammit!

The other passengers, silver-haired tourists all, seem to be giving me a wide berth.

Videogames are wicked and evil – don't let anyone tell you different.

As the smooth gray water slowly soothes my nerves, I reflect on the problems I had back at the arcade. Is it the hardware? Is it the software? Is it me? All three?

Fortunately, I'm sailing to Sausalito to see a man who thinks about racing simulation for a living.

Get real

"Well what do you want? Those are games, not sims." I'm sitting in a sparsely furnished, comfortably dis-

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Rob Riddell (100626.1717@compuserve.com) *wrote about Speed Week at the Bonneville Salt Flats in "Salt of the Earth" (*Wired *4.11).*

PHOTOS: NORMAN MAUSKOPF

organized office overlooking the edge of a marina. Outside, sailboats are parked next to cars. There's not a tourist in sight. And Garry Hare is listening to my complaints with a knowing smile.

"Here's what a simulation has: real control." He levels a patient stare at me, lets that sink in. Hare is the founder and president of Fathom Pictures, a producer of high-end CD-ROMs. He's 50, tall, balding. He speaks softly and thoughtfully, using the minimum of gesture – a pause, a cocked eyebrow – for emphasis.

"Real control."

"Real control. Real physics, and real control."

The goal of both games and sims is to seize your imagination and hang onto it as long as possible. Although both can be (and generally aim to be) exciting and habit-forming, Hare says, the similarities pretty much end there.

Games, the theory goes, employ the classic psychological tool of "partial reinforcement" – intermittent but immediate gratification, not too much, not too little – to attract their users' quarters and attention. Imagine lab rats pressing a bar and getting a food pellet 50 percent of the time. Same idea. The learning curve can't be too steep. And since the goal is entertainment and diversion, games can play fast and loose with realism. Confronted by an 8-foot-tall, armed gorilla? Jump over him! Crash into a wall at 140 mph? Well, dust yourself off and keep movin'!

On the other hand, if a simulation lets you do something that you can't do in real life, that's a flaw. Gratification doesn't have to be immediate, and the learning curve can be (and generally is) quite steep. A good sim provides not a linear sequence of predetermined events and challenges, but a whole universe of possibilities, maximum choice and control. Hit a wall at 40 mph in a sim and that's the end of your race. Make an adjustment to your front spoiler and it can be three laps before you even notice the difference in performance. Just like real life.

A game is an alternate universe; a sim is a parallel universe.

"In terms of how a simulation looks and responds," Hare tells me, "sim fans want realism, period."

Hare's programmers are hard at work on a title called *Bob Bondurant's High Performance Driving*, which is based on and affiliated with the celebrated driving school in Phoenix. To be released in spring 1997, it will be marketed toward the average *Car and Driver* subscriber. Hare has spared no effort in the pursuit of the grail of realism.

"For the physics engine," he tells me, leaning back in his chair, "we started with that." He points to a dauntingly thick book that dominates a shelf across the room. "Auto racing physics tables. Then I sent my coders to study with one of the best chassis designers in the world. We want that Mustang on your screen to drive exactly like one of Bondurant's, so we're modeling it from the wheels up. For visual and audio realism, we took 360-degree photographs of the sky and landscape around the track. We put microphones in the engine wells of every car and recorded them from idle up to redline. Everything – sound, graphics, dashboard readout – is linked to the physics engine."

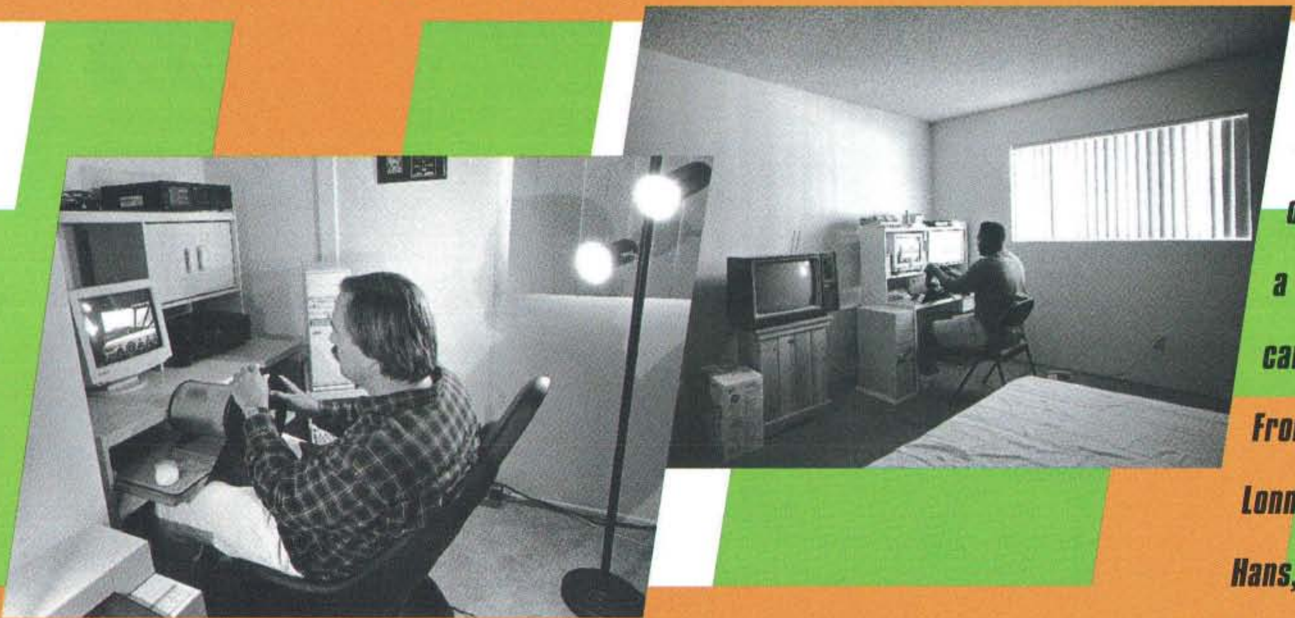
Hare's goal is nothing less than the most realistic driving experience you can have outside a car.

He's got some competition.

Simulation city

The history of PC-based racing-sims is fairly recent, and dominated by two companies. In 1989, Massachusetts-based Papyrus launched what could be called the first desktop racing-sim: *Indianapolis 500 – The Simulation*. Back then, top-of-the-line PCs

199 ▶



Neglect your job, your friends, and your loved ones. Blow $1,300 on a steering wheel. If you can't live it, simulate it.

From opposite left: Lonnie Larkan, Greg Hans, and Rhawn Black.

LIFESTREAMS

According to David Gelernter, the desktop metaphor is obsolete. He wants to move beyond space – to time.

By Steve G. Steinberg

Illustration By Jeff Brice

www.wired.com/ 5.02/lifestreams/

David Gelernter is looking for his pipe. It's hidden somewhere in his office, among the leaning towers of books, academic reprints, old newspapers, and empty Diet Sprite cans. He ducks and whirls his head around until he spots it on a bookshelf, right next to a copy of the programming linguistics textbook he cowrote, and gives a satisfied smile. But as he fiddles with the pipe, twisting it around and tapping it against the desk, then looking blankly at a bag of tobacco as if unsure what to do, the smile becomes sheepish. He mutters something about affectations and puts the pipe down.

The 41-year-old Yale computer science professor is accustomed to being at the forefront of his field. He codeveloped a successful programming language for parallel computing back when parallel computing was still considered impractical, and he worked on techniques for data mining years before it became a buzzword. But his current project is the most far afield yet. Instead of researching faster hardware or more efficient algorithms, Gelernter is examining the human side of the equation. His team at Yale is studying things like cognitive psychology, design – social sciences, even. And sometimes, he looks like an actor trying to learn a new role.

Gelernter's desk is littered with piles of books that almost entirely obscure the man behind the desk. Clearly this is not someone who would place much confidence in the idea of the "desktop metaphor."

The project that Gelernter and several of his graduate students are working on is called Lifestreams, and it may completely change how we manage information. Today, our view of cyberspace is shaped by a 20-year-old metaphor in which files are documents, documents are organized into folders, and all are littered around the flatland known as the desktop. Lifestreams takes a completely different approach: instead of organizing by space, it organizes by time. It is a diary rather than a desktop.

This is a more radical vision than it seems. For years, attempts to replace the desktop have been based on simply taking it to the next dimension – the third dimension. Even the cyberspace of science fiction remains profoundly spatial. Recall William Gibson's description: "A graphic representation of data abstracted from the banks of every computer in the human system. Unthinkable complexity. Lines of light ranged in the nonspace of the mind, clusters and constellations of data. Like city lights, receding."

Gelernter's group takes Gibson's cyberspace and twists it around the temporal axis. You hear this in its description of Lifestreams: "Every document you've ever created or received stretches before you in a time-ordered stream, reaching from right now backward to the date you were born. You can sit back and watch new documents arrive: they're plunked down at the head of the stream. You browse the stream by running your cursor down it – touch a document in the display and it pops out far enough for you to glance at its contents. You can go back in time or go to the future and see what you're supposed to be doing next week or next decade. Your entire cyberlife is right there in front of you."

This view of the future is startling, partly because the idea is so obvious. It seems incredible that a good system for organizing chronologically doesn't already exist. But, as anyone who has tried to keep track of many different versions of a document and has had to resort to intricate filenames like *letter.4/12.sgs.b* knows, today's interfaces practically ignore the temporal dimension.

Almost as radical as the ideas of Lifestreams is that the project was developed by a computer science professor. This breaks with years of academic tradition, which insists that developing practical, easy-to-use applications isn't real research. It's hard to predict whether Lifestreams will have the impact of, say, Xerox PARC's desktop. But just the fact that Lifestreams came from a university, rather than a company or research lab, reveals plenty about where computing is headed.

Taking the *S* out of CS

"Computer science departments have always considered 'user interface' research to be sissy work," MIT's Nicholas Negroponte replies when I ask him why UI has historically been ignored by academics. The real men (yes, they were mainly men) studied topics like compilers, systolic arrays, and partitioning algorithms. This was hard science, and it involved numbers, mathematical proofs, and empirical evidence. *User interface*? That was on par with astrology.

The few academics who do study user interface have their own, more blunt way of explaining the field's historical marginalization. "User interfaces have to do with people, and computer scientists don't like to work on problems involving people," says Stuart Card, a leading interface researcher at Xerox PARC. But no matter

204 ▶

PHOTO: STEVEN FUGIKAWA

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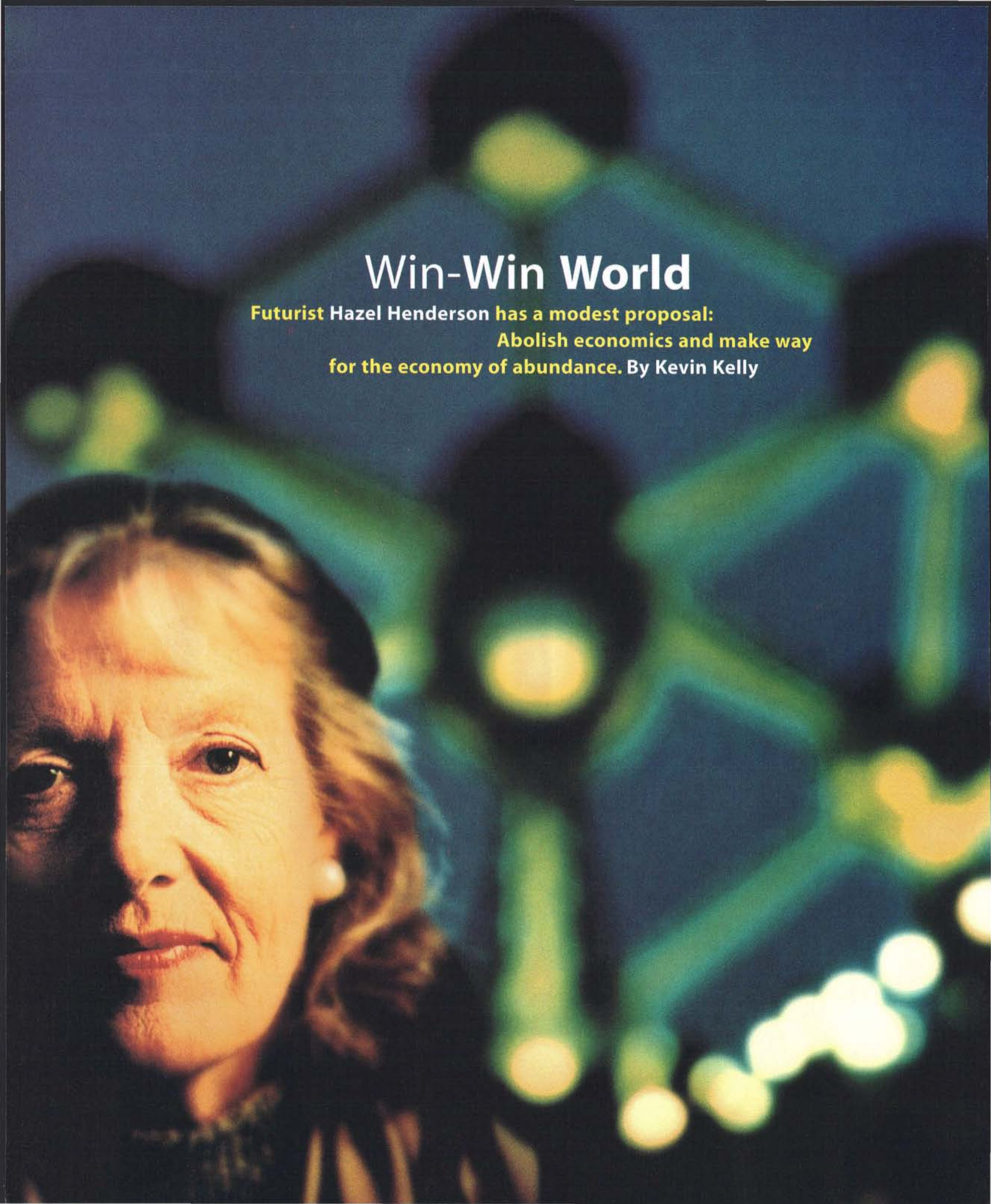
Win-Win **World**

Futurist **Hazel Henderson** has a modest proposal: Abolish economics and make way for the economy of abundance. **By Kevin Kelly**



Wired: Is the information age knocking the underpinnings out from under traditional economics?

Henderson: Oh yes. Economics was about scarcity, about setting up turnstiles and gatekeepers and all that. But as we move away from the idea that we're shoveling dirt around, economics can't be overhauled anymore.

So it's useless?

Pretty much. The important insights now are in game theory and systems theory. But the economics profession remains really powerful. Poor people don't hire economists - it's banks, brokers, and large corporations who need someone to jawbone the Fed to raise interest rates.

But haven't economists like Paul Romer and Brian Arthur, who do appreciate the power of technology, restored some of its relevance?

Systems theorists have understood this for years! What else is new? I'm always telling Brian that he has transcended economics. But if he admitted that, he'd never win the Nobel Prize.

What will it take to get more people to understand this?

The systemic learning experience we need is a really big stock market crash. The scenario goes like this: The consumer price index, by overstating inflation, has all the central banks in herd behavior, circling the wagons. That makes it very easy to tip large economies into a deflation that would be very hard to stop. Then people stop borrowing money, and you end up in a spiral.

You've called the current economic situation a modern "tragedy of the commons."

I'm talking about things like the electromagnetic spectrum. When we started out, it was wide open. Today it's filled up, to the point where we need to prioritize. The intelligent thing would be to call a conference of users.

Who sets the rules?

Left to the invisible hand, it will be the lowest common denominator, usually the mafia. Look at eastern Europe.

Shouldn't private organizations set the standards? After all, they provide the technology and capital.

That can be a good idea, as long as it's done in the open. I'm very happy about the global standard-setting that business has been doing. But we have to make sure that information about how standards are set gets out there. That's how you make markets accountable.

What role should governments play?

National governments gave away a lot of autonomy in the 1980s, when they deregulated, accepted GATT and NAFTA, and all the rest. So power must be pooled again at the international level, where you can forge agreements that recapture some power over global corporations. That's why I'm interested in the UN - it's the only international broker we have. The UN already sets standards, through organizations like the International Air Transport Association. For 50 years the UN has engaged in quiet norm-setting. It's one of our best hopes.

What's the biggest economic shift you see coming now?

The demise of banking. If the bankers don't extend credit, if money isn't democratized, we'll go around them.

How?

High tech bartering. We could not go around the money system until people had computers and the Internet, because bartering is clunky. But now you can do four-, five-, or six-way trades, where you say, "We want bananas, these people have tin, and these people have copper to sell," and computers keep track.

What about locally based currencies?

We need three currencies. A global reserve currency, for trade transactions. We need national currencies, in which I include food stamps, student loans, vouchers for this and that. And then there are locally based systems - computer barter and local currencies. This would allow a huge paradigm shift, because money wouldn't be scarce. And people would have the option of not running around, not getting and spending money.

Won't, say, Citibank find ways to co-opt this?

The old giants can't turn their ships around fast enough. Their business is the business of scarcity. What we're talking about is the abundance business, where anyone can make a market in anything. Big companies are terrified of this. They're offering cash accounts and smartcards, but this is simply recycling. They can't get the idea that we don't need the money loop. If you're Citibank, and you have all that sunk capital - all your core competencies are in manipulating the money loop - then you're sunk if people begin to turn away.

Is a profession that missed the biggest change since the Industrial Revolution worth saving? British-born futurist Hazel Henderson doesn't think so. A veteran technocrat - with stints at the US Office of Technology Assessment and the National Science Foundation - she now spends her time lecturing corporate chiefs and labor leaders alike on coming to grips with economic realities that increasingly defy conventional economics. In between she retreats to a cottage off the Florida coast to write, most recently *Building a Win-Win World: Life beyond Global Economic Warfare*.

***Wired* caught up with Henderson in San Francisco, where she was chairing the economics panels at Mikhail Gorbachev's State of the World forum.**

So are we heading toward perfect competition?

We're going to see a balance of cooperation and competition. We got lost in the 18th-century textbooks, which saw only the competitive side. We haven't seen the utility of the cooperation side, the standard-setting side, the side that creates protocols in information markets.

Are economists starting to see that?

Economics is trying to recycle itself by grabbing insights from other disciplines. Economists are running around saying, "We're chaos theorists, we're game theorists." But they're coming off too narrow a framework. And for every economist who has finally got the message that technology creates abundance, there are dozens pointing in the opposite direction. ■ ■ ■

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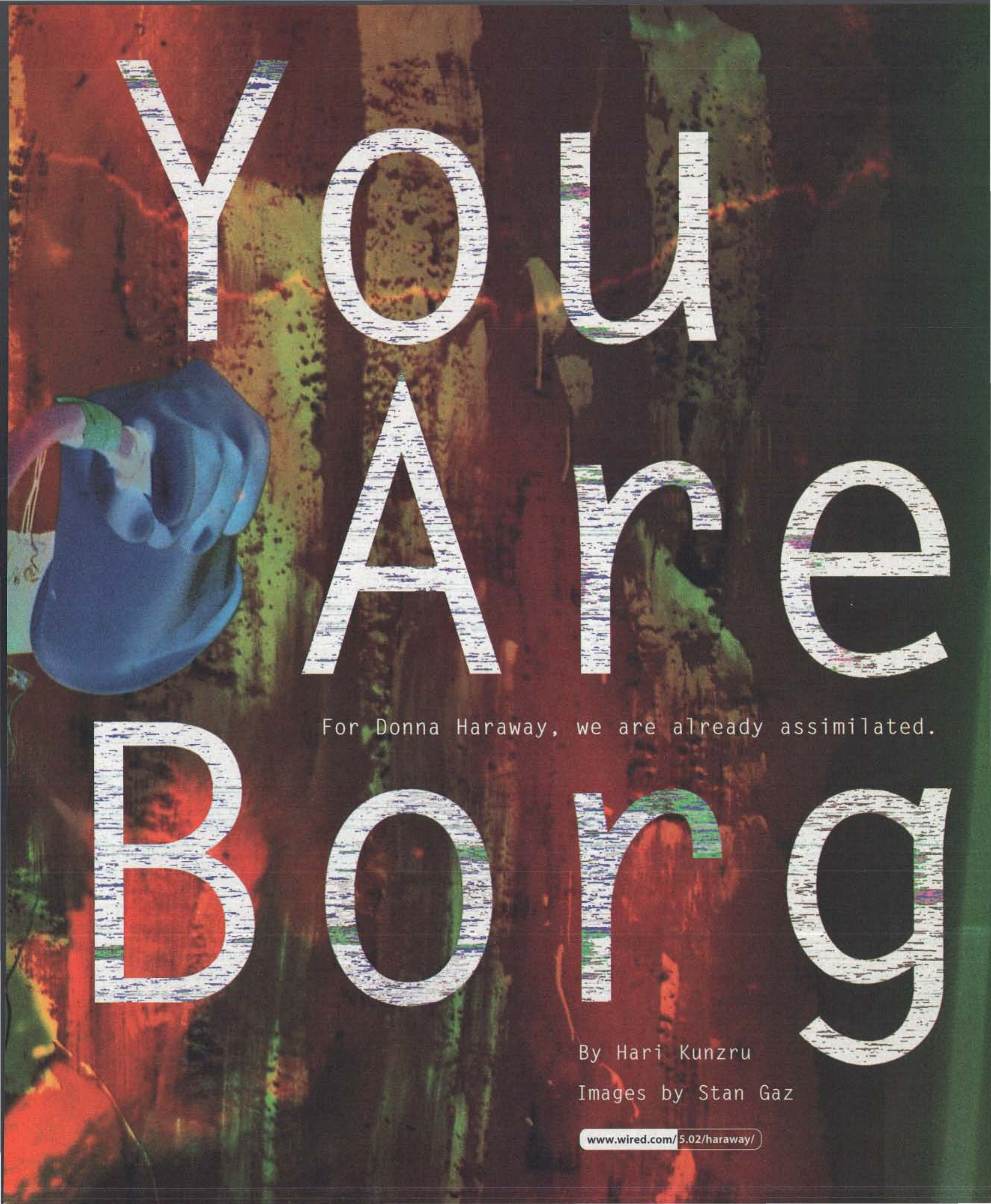
PHOTO: NEILS VAN ILPERN



You Are Borg

For Donna Haraway, we are already assimilated.

By Hari Kunzru

Images by Stan Gaz

www.wired.com/5.02/haraway/

The monster opens the curtains of Victor Frankenstein's bed. Schwarzenegger tears back the skin of his forearm to display a gleaming skeleton of chrome and steel. Tetsuo's skin bubbles as wire and cable burst to the surface. These science fiction fevered dreams stem from our deepest concerns about science, technology, and society. With advances in medicine, robotics, and AI, they're moving inexorably closer to reality. When technology works on the body, our horror always mingles with intense fascination. But exactly how does technology do this work? And how far has it penetrated the membrane of our skin?

The answers may lie in Sonoma County, California. It's not the most futuristic place in the world; quite the opposite. The little clusters of wooden houses dotted up and down the Russian River seem to belong to some timeless America of station wagons and soda pop. Outside the town of Healdsburg (population 9,978), acres of vineyards stretch away from the road, their signs proudly proclaiming the dates of their foundation. The vines themselves, transplants from Europe, carry a genetic heritage far older. Yet this sleepy place is where visions of a technological future are being defined. Tucked away off the main highway is a beautiful redwood valley. Here, in a small wooden house, lives someone who says she knows what's really happening with bodies and machines. She ought to - she's a cyborg.

Meet Donna Haraway and you get a sense of disconnection. She certainly doesn't look like a cyborg. Soft-spoken, fiftyish, with an infectious laugh and a house full of cats and dogs, she's more like a favorite aunt than a billion-dollar product of the US military-industrial complex. Beneath the surface she says she has the same internal organs as everyone else - though it's not exactly the sort of thing you can ask her to prove in an interview. Yet Donna Haraway has proclaimed herself a cyborg, a quintessential technological body. (See "The Cyborg Ancestry.")

Sociologists and academics from around the world have taken her lead and come to the same conclusion about themselves. In terms of the general shift from thinking of individuals as isolated from the "world" to thinking of them as nodes on networks, the 1990s may well be remembered as the beginning of the cyborg era.

As professor of the history of consciousness at the University of California, Santa Cruz, Haraway is a leading thinker about people's love/hate relationship with machines. Her ideas have sparked an explosion of debate in areas as diverse as primatology, philosophy, and developmental biology. To boho twenty-somethings, her name has the kind of cachet usually reserved for techno acts or new phenethylamines. Her latest book, the baroquely titled *Modest_Witness @Second_Millennium.FemaleMan©_Meets_ OncoMouse™* (1997, Routledge), is her first in five years and has been as eagerly awaited as any academic text of recent times. In the book, Haraway concentrates on biological networks and takes a critical look at the way biotechnology is constructing our bodies. She tackles masculine bias in scientific culture and sees herself as the troubled "modest witness" of the ethical maelstrom of genetic engineering. Haraway scrupulously observes and records - unable to be silent about what she sees. She's also become a heroine to a generation of women who are starting to call themselves cyberfeminists.

Cyberfeminism, says Sadie Plant, director of the Centre for Research into Cybernetic Culture at Warwick University in England, is "an alliance between women, machinery, and new technology. There's a long-standing relationship between information technology and women's liberation." It's a view that is resonating with feminist thinkers. Academics like Katherine Hayles have taken Haraway's ideas into literary theory, while male-to-female transgendered theorist and performer Allucquère Rosanne Stone has shocked traditional academia with her eccentric accounts of the technological transformation of her own body. Haraway's most famous essay, "The Cyborg Manifesto," first published in 1985, has become part of the undergraduate curriculum at countless universities.

The Left Coast leaning

Haraway herself is a veteran of '60s counterculture, not a scene known for its faith in technological transformation. She has that aura of slightly cynical wisdom you get if you spend long enough fighting for left-wing causes. So it's startling how opposed her ideas are to the back-to-nature platitudes that dominate the old West Coast stereotype. This is a woman who has no interest in being an earth mother or harking back to some mythical pretechnological past. She once famously declared, "I'd rather be a cyborg than a goddess," flying in the face of received feminist wisdom that science and technology are patriarchal blights on the face of nature. As a cyborg,

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Hari Kunzru (hari@wired.co.uk) *is associate editor of* Wired *UK.*

PHOTO: WILLIAM ZEMANEK

Haraway is a product of science and technology, and she doesn't see much point in the so-called goddess feminism, which preaches that women can find freedom by sloughing off the modern world and discovering their supposed spiritual connection to Mother Earth. When Donna Haraway says she's a cyborg, she's not claiming to be different or special. For Haraway, the realities of modern life happen to include a relationship between people and technology so intimate that it's no longer possible to tell where we end and machines begin. In fact, she's not the only cyborg in Healdsburg. There are 9,978 of them.

Sitting on the porch, listening to Haraway explain her ideas over a background of singing birds and buzzing insects, it's hard not to feel she's talking about some parallel world, some chrome-and-neon settlement in a cyberpunk novel. "We're talking about whole new forms of subjectivity here. We're talking seriously mutated worlds that never existed on this planet before. And it's not just ideas. It's new flesh."

But she is not talking about some putative future or a technologically advanced corner of the present. The cyborg age is here and now, everywhere there's a car or a phone or a VCR. Being a cyborg isn't about how many bits of silicon you have under your skin or how many prosthetics your body contains. It's about Donna Haraway going to the gym, looking at a shelf of carbo-loaded bodybuilding foods, checking out the Nautilus machines, and realizing that she's in a place that wouldn't exist without the idea of the body as high-performance machine. It's about athletic shoes.

"Think about the technology of sports footwear," she says. "Before the Civil War, right and left feet weren't even differentiated in shoe manufacture. Now we have a shoe for every activity." Winning the Olympics in the cyborg era isn't just about running fast. It's about "the interaction of medicine, diet, training practices, clothing and equipment manufacture, visualization and timekeeping." When the furor about the cyborgization of athletes through performance-enhancing drugs reached fever pitch last summer, Haraway could hardly see what the fuss was about. Drugs or no drugs, the training and technology make every Olympian a node in an international technocultural network just as "artificial" as sprinter Ben Johnson at his steroid peak.

If this sounds complicated, that's because it is. Haraway's world is one of tangled networks - part human, part machine; complex hybrids of meat and metal that relegate old-fashioned concepts like *natural* and *artificial* to the archives. These hybrid networks are the cyborgs, and they don't just surround us - they incorporate us. An automated production line in a factory, an office computer network, a club's dancers, lights, and sound systems - all are cyborg constructions of people and machines.

Networks are also inside us. Our bodies, fed on the products of agribusiness, kept healthy - or damaged - by pharmaceuticals, and altered by medical procedures, aren't as natural as The Body Shop would like us to believe. Truth is, we're constructing ourselves, just like we construct chip sets or political systems - and that brings with it a few responsibilities. Haraway has no doubt that to survive we need to get up to speed on the complex realities of technoculture. To any of the usual good/bad, nature/nurture, right/wrong, biology/society arguments, she smiles, breaks into her infectious, ironic laugh, and reminds us that the world is "messier than that." It might well become the quintessential 21st-century catchphrase.

The ironic political myth

"The Cyborg Manifesto" is a strange document, a mixture of passionate polemic, abstruse theory, and technological musing. Haraway calls it "an ironic political myth." It pulls off the not inconsiderable trick of turning the cyborg from an icon of Cold War power into a symbol of feminist liberation - not bad for the first thing she wrote on her newly acquired computer.

In the manifesto, Haraway argues that the cyborg - a fusion of animal and machine - trashes the big oppositions between nature and culture, self and world that run through so much of our thought. Why is this important? In conversation, when people describe something as natural, they're saying that it's just how the world is; we can't change it.

Women for generations were told that they were "naturally" weak, submissive, overemotional, and incapable of abstract thought. That it was "in their nature" to be mothers rather than corporate raiders, to prefer parlor games to particle physics. If all these things are natural, they're unchangeable. End of story. Return to the kitchen. Do not pass Go.

On the other hand, if women (and men) aren't natural but are constructed, like a cyborg, then, given the right tools, we can all be *reconstructed*. Everything is up for grabs, from who does the dishes to who frames the constitution. Basic assumptions suddenly come into question, such as whether it's natural to have a society based on violence and the domination of one group by another. Maybe humans are biologically destined to fight wars and trash the environment. Maybe we're not.

Feminists around the world have seized on this possibility. Cyberfeminism - not a term Haraway uses - is based on the idea that, in conjunction with technology, it's possible to construct your identity, your sexuality, even your gender, just as you please.

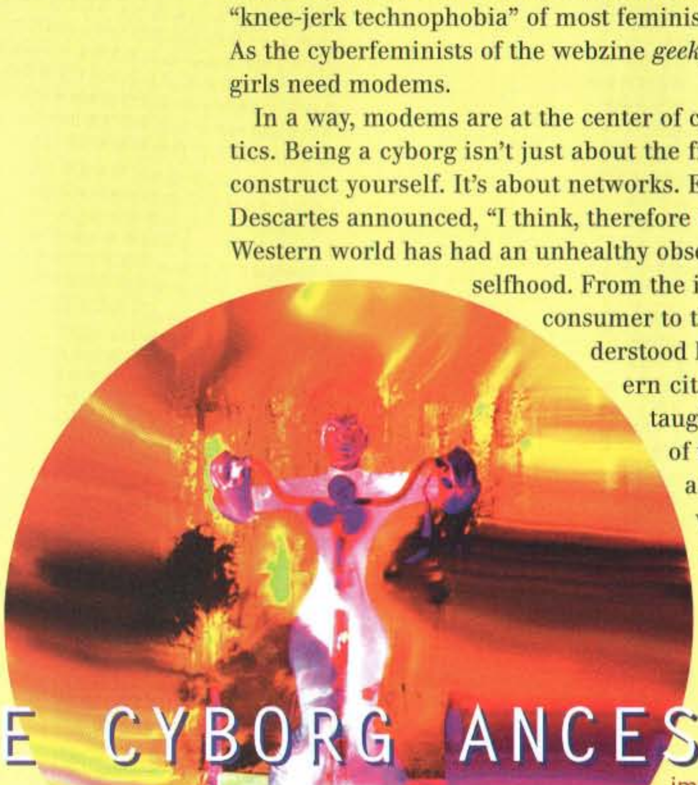
Being a cyborg isn't about how many bits of silicon you have under your skin or how many prosthetics your body contains. It's about athletic shoes.

In contrast to the prohibition-based feminism of the so-called political correctness movement, which concentrates on trying to police sexuality and legislate against "inappropriate" behavior, the cyberfeminists revel in polymorphous perversity. They form a broad church (after all, everything is permitted), its expressions ranging from sober historical analyses of women as technologists to the assertions of Australian art group VNS Matrix that the clitoris is a tool for jacking into a higher-order cyberspace. Haraway is no happy-clappy technology groupie – she's harshly critical of techno-utopians, including some of those found between the covers of this magazine. But she's also no fan of what she calls the "knee-jerk technophobia" of most feminist politics. As the cyberfeminists of the webzine *geekgirl* put it, girls need modems.

In a way, modems are at the center of cyborg politics. Being a cyborg isn't just about the freedom to construct yourself. It's about networks. Ever since Descartes announced, "I think, therefore I am," the Western world has had an unhealthy obsession with selfhood. From the individual consumer to the misunderstood loner, modern citizens are taught to think of themselves as beings who exist inside their heads and only secondarily come into contact with everything else. Draw a circle. Inside: me. Outside: the world. Philosophers agonize about whether the reality outside that circle even exists. They have a technical term for their neuroses – *skepticism* – and perform intellectual acrobatics to make it go away. In a world of doubt, getting across that boundary, let alone to other people, becomes a real problem.

Unless, that is, you're a collection of networks, constantly feeding information back and forth across the line to the millions of networks that make up your "world." A cyborg perspective seems rather sensible, compared with the weirdness of the doubting Cartesian world. As Haraway puts it, "Human beings are always already immersed in the world, in producing what it means to be human in relationships with each other and with objects." Human beings in the '90s show a surprising willingness to understand themselves as creatures networked together. "If you start talking to people about how they cook their dinner or what kind of language they use to describe trouble in a marriage, you're very likely to get notions of tape loops, communication breakdown, noise and signal – amazing stuff." Even while we mistake ourselves for humans, the way we talk shows that we know we're really cyborgs.

But isn't this just rhetoric? It's all very well talking about cyborgs, but is there any need to seriously believe in the idea? Yes, says Haraway. "Feminist concerns," she argues vehemently, "are inside of technology, not a rhetorical overlay. We're talking about cohabitation: between different sciences and



THE CYBORG ANCESTRY

Cyborg. The word has a whiff of the implausible about it that leads many people to discount it as mere fantasy. Yet cyborgs, real ones, have been among us for almost 50 years. The world's first cyborg was a white lab rat, part of an experimental program at New York's Rockland State Hospital in the late 1950s. The rat had implanted in its body a tiny osmotic pump that injected precisely controlled doses of chemicals, altering various of its physiological parameters. It was part animal, part machine.

The Rockland rat is one of the stars of a paper called "Cyborgs and Space," written by Manfred Clynes and Nathan Kline in 1960. This engineer/psychiatrist double act invented the term *cyborg* (short for "cybernetic organism") to describe the vision of an "augmented man," better adapted than ordinary humans to the rigors of space travel. Clynes and Kline imagined a future astronaut whose heart would be controlled by injections of amphetamines and whose lungs would be replaced by a nuclear-powered "inverse fuel cell."

From the start, the cyborg was more than just another technical project; it was a kind of scientific and military daydream. The possibility of escaping its annoying bodily limitations led a generation that grew up on Superman and Captain America to throw the full weight of its grown-up R&D budget into achieving a real-life superpower. By the mid-1960s, cyborgs were big business, with millions of US Air Force dollars finding their way into projects to build exoskeletons, master-slave robot arms, biofeedback devices, and expert systems. For all the big bucks and high seriousness, the prevailing impression left by old cyborg technical papers is of a rather expensive kind of science fiction. Time and again, scientific reaforms of culture, between organisms and machines. I think the issues that really matter - who lives, who dies, and at what price - these political questions are embodied in technoculture. They can't be got at in any other way." For Haraway and many others, there's no longer any such thing as the abstract.

To illustrate the point, Haraway begins to talk about rice.

"Imagine you're a rice plant. What do you want? You want to grow up and make babies before the insects who are your predators grow up and make babies to eat your tender shoots. So you divide your energy between growing as quickly as you can and producing toxins in your leaves to repel pests. Now let's say you're a researcher trying to wean the Californian farmer off pesticides. You're breeding rice plants that produce more alkaloid toxins in their leaves. If the pesticides are applied externally, they count as chemicals - and large amounts of them find their way into the bodies of illegal immigrants from Mexico who are hired to pick the crop. If they're inside the plant, they count as natural, but they may find their way into the bodies of the consumers who eat the rice."

International border controls, the question of natural versus artificial, the ethics of agribusiness, and even the politics of labor regulation are networked together with the biology of rice plants and pests. Who lives? Who dies? That's what Haraway means when she talks about politics being inside technoculture. We can't escape it. It's just that sometimes it's hard to see.

The religion of biology

Maybe it was inevitable that Haraway would wind up blending science and politics and thus breaking one of the big taboos. While studying for a biology doctorate at Yale in the late '60s, Haraway realized "what I was really interested in was not so much biology as a research science, but the way it was a part of politics, religion, and culture in general." Part of a commune active in gay liberation, women's rights, and civil rights; part of a graduate biology program "up to its ears in anti-Vietnam War work centering around chemical herbicides"; and part of a university integral to the military-industrial complex prosecuting the war, she could hardly help being political.

Her doctoral work in cell biology ("nothing bigger than a microbe") dragged on, and she found herself in Hawaii, teaching general science to kids destined to be hotel staffers and tour guides. She had gone there with her husband, Jaye Miller, who was actively gay and a fellow commune member. "We figured out ultimately that we wanted to do a little brother-sister incest, but at the time we didn't have any other model than getting married." A few years later, they "stopped being married" but continued to live as part of the same household, along with their respective partners, until Miller's death from an AIDS-related illness in 1991.

The immune system has since figured frequently in Haraway's work - as an information system; as something that wasn't even clearly understood as a single entity until the 1960s; as she says in her book *Simians, Cyborgs, and Women*, a "potent and 209 ►

"The issues that really matter - who lives, who dies, and at what price - are embodied in technoculture. They can't be got at in any other way."

soning melts into metaphysical speculation about evolution, human boundaries, and even the possibility of what Clynes and Kline call "a new and larger dimension for man's spirit." The cyborg was always as much a creature of scientific imagination as of scientific fact.

It wasn't only the military that was captivated by the possibilities of the cyborg. The dream of improving human capabilities through selective breeding had long been a staple of the darker side of Western medical literature. Now there was the possibility of making better humans by augmenting them with artificial devices. Insulin drips had been used to regulate the metabolisms of diabetics since the 1920s. A heart-lung machine was used to control the blood circulation of an 18-year-old girl during an operation in 1953. A 43-year-old man received the first heart pacemaker implant in 1958.

By the 1970s, the idea of an augmented human had entered the mainstream. Steve Austin, The Six Million Dollar Man, and his cohort Jaime Sommers, The Bionic Woman (with bionic limbs and a supersensitive bionic ear), were popular heroes, their custom superpowers bought off the shelf like a digital watch. The cyborg had grown from a lecture-room fantasy into the stuff of prime-time TV.

Of course robots, automata, and artificial people have been part of the Western imagination since at least as far back as the Enlightenment. Legendary automaton builder Wolfgang von Kempelen built a chess-playing tin Turk and became the toast of Napoleonic Europe. Mary Shelley's Frankenstein built a monster out of body parts and activated it with electricity. Even the Indian national epic, the *Mahābhārata*, composed about 300 BC, features a lion automaton.

One thing makes today's cyborg fundamentally different from its mechanical ancestors - information. Cyborgs, Haraway explains, "are information machines. They're embedded with circular causal systems, autonomous control mechanisms, information processing - automa- 210 ►

BEYOND STARWA

NO DIRECTOR has fast-forwarded filmdom into the 21st century as far as George Lucas has. His popular galactic fairy tale Star Wars is the classic saga of a charming princess and brave knights, but also of very unclassical warp drives, Wookies, bots, and droids. Lucas's mythmaking is a novel convergence of Hans Christian Andersen and Isaac Asimov, the blending of soul and tech, the meeting of inner child and inner nerd.

IN THE LATE '70s, Lucas fleshed out the scope of his interplanetary opera with a new cinematographic technique: computers married to cameras. He used technology not to make his tale unbelievable, but to make it ultrabelievable. Each new installment of the trilogy – The Empire Strikes Back, then Return of the Jedi – revved up the cinematic wizardry by making the special effects more potent yet less visible.

THIS MONTH Lucas and company have reissued the first Star Wars episode with additional scenes and superior effects, in effect declaring that a movie is a dynamic creation (like a Web page!) that can be forever tweaked. Ever the rebel, Lucas is busy conjuring up the next revolution – an innovative way of "nonlinear 3-D filmmaking" that we bet will become the dominant form of cinema production on the other side of 2000. Soon in the future, Lucas predicts, in a garage not very far away, two guys will use digital video technology to make a movie you'll never forget. ▶

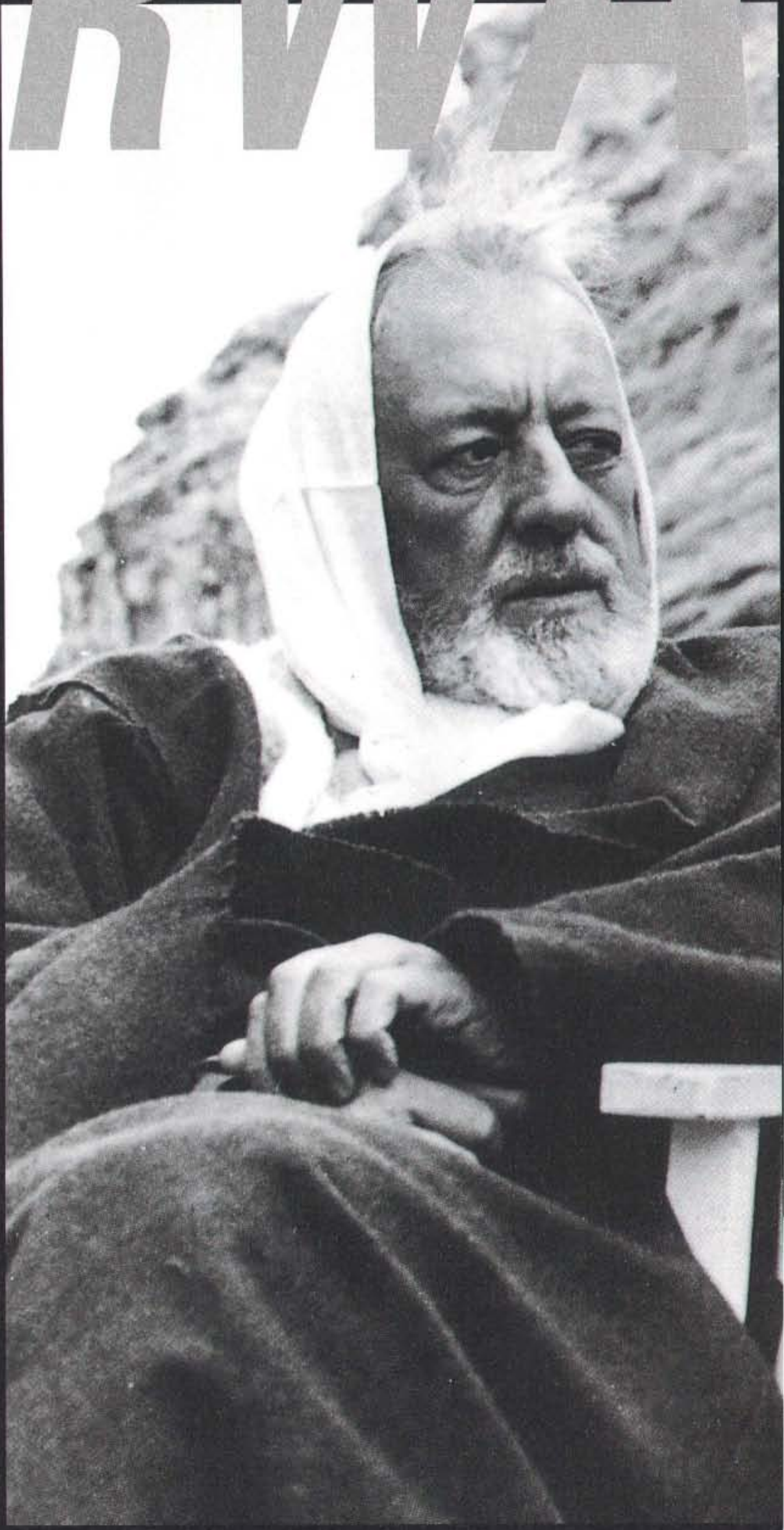


IMAGE: UPI/CORBIS-BETTMANN

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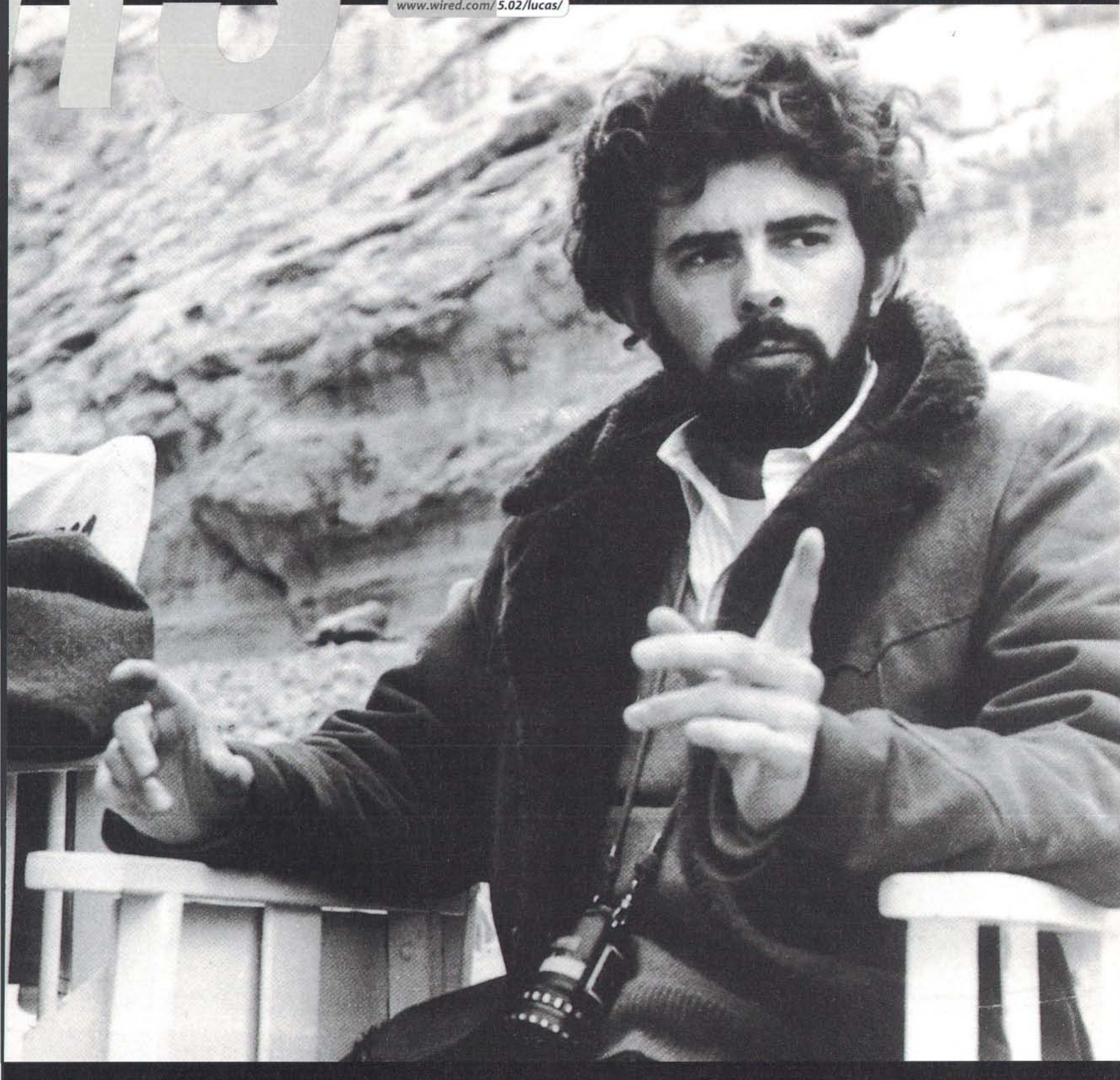
WHAT'S NEXT FOR GEORGE LUCAS

The Wired Interview

by Kevin Kelly and Paula Parisi

www.wired.com/5.02/lucas/



Wired: What has surprised you in the last 10 years?
Lucas: A lot of the things that I believed in in the past are coming to pass.

Such as?
What I call 3-D filmmaking. In 3-D filmmaking, I can take images and manipulate them infinitely, as opposed to taking still photographs and laying them one after the other. I move things in all directions. It's such a liberating experience. It's like you said "I wish I could fly" and then the Wright Brothers come along, and then you can fly, and you can't get over the fact that it is so astounding. I am still in that phase of saying "This is so amazing."

Everything seems to be going digital. When do you expect to make a complete movie using just a videocamera and no film?

> *"WHAT I CALL 3-D FILMMAKING IS SUCH A LIBERATING EXPERIENCE. INSTEAD OF A SEQUENTIAL ASSEMBLY-LINE PROCESS, IT'S LIKE THE PROCESS OF A PAINTER OR SCULPTOR."*

Well, we were going to do the next one with all video, but we're having a little problem with the wide-screen format, so we may not be able to accomplish it on this film. But the next one we will. Definitely. If I wasn't doing wide screen, I could do it today.

In two years you'll make a completely digital feature with no film?
Yes. Two or three years.

What have you changed in the reissued *Star Wars* films? Have you created new characters?
In *The Empire Strikes Back* there was a snow monster you didn't really see. It was just shadows and sounds; we always wanted the creature but were never able to accomplish it. Now we actually have a creature there. We have a lot of new shots in Cloud City to make it be bigger and look better. And the snow sequence was one of those state-of-the-art things at the time – doing white mattes on a white surface, which nobody had ever accomplished. Now, with digital, we can do that much better. In *Jedi*, there was a sequence in Jabba's palace that was meant to be a musical number. But it ended up just a little tiny thing with this dancer, Ula, that was maybe 15 seconds long. Now we've turned that into about a minute and a half. There's a bigger band and backup singers. It is what it was meant to be originally; we just didn't have the wherewithal to do it then.

That makes new films cheaper, too! You were once trying to cut moviemaking's economies of scale down to one-tenth the normal cost. What will your *Star Wars* prequels cost?
I'm hoping to do the new *Star Wars* films for between US$60 and $70 million. These are maybe $120 to $140 million movies.

That's amazing! A talking-head drama like *The Bridges of Madison County* costs maybe $50 million. How are you making a new *Star Wars* installment for only $10 million more?
This first film will be a big experiment, because we're taking a lot of the ideas I've learned from doing the *Young Indy* TV series and moving it to this larger level to see what happens. Some of it is going to work; some of it's not. The reason I'm directing the first one is so I can learn how to do it myself. We're going out there in a whole different style of filmmaking.

You say you don't intentionally set yourself up as godfather of the digital era, but is what you are working on the paradigm for 21st-century filmmaking?
People ask me about it more, I guess, but other people are doing it, too. Imagine having to publish a story the way films are made. The publisher does the outline, then turns it over to you, the "writer," and says, "OK, write the story." You write it, but once you've written there's no such thing as being able to take words out and change them around. Then you turn it over to me, the editor. The editor says, "Now, I'm going to put it in my wordprocessor. I'm going to move everything around," and he does. You get to check in once in a while and say, "No, no, that's not what I meant. I meant this." "Oh, really, I had no idea that's what you were talking about. OK, I'll put that." And then you turn it over to the printer, the printer retypes it however he wants, and then prints it that way. Then you say, "But you can't do that!" That is the way it's done in movies.

We've all got a wordprocessor now, so why not just let one person do the whole thing? You can say about halfway through the story, Gee, we should add this new section in the outline and put it in there because that's even better.

Writers say they write to find out what they think. Are you saying that you can't determine what the movie is really about until you film it?
It's very hard to have planned out at the very beginning what is going to happen at the very end. Obviously real life comes into it, personalities come into it, and the process of doing it sequentially forces you into making certain kinds of decisions in a certain way. Instead of making film into a sequential assembly-line process where one person does one thing, takes it, and turns it over to the next person, I'm turning it more into the process of a painter or sculptor. You work on it for a bit, then you stand back and look at it and add some more onto it, then

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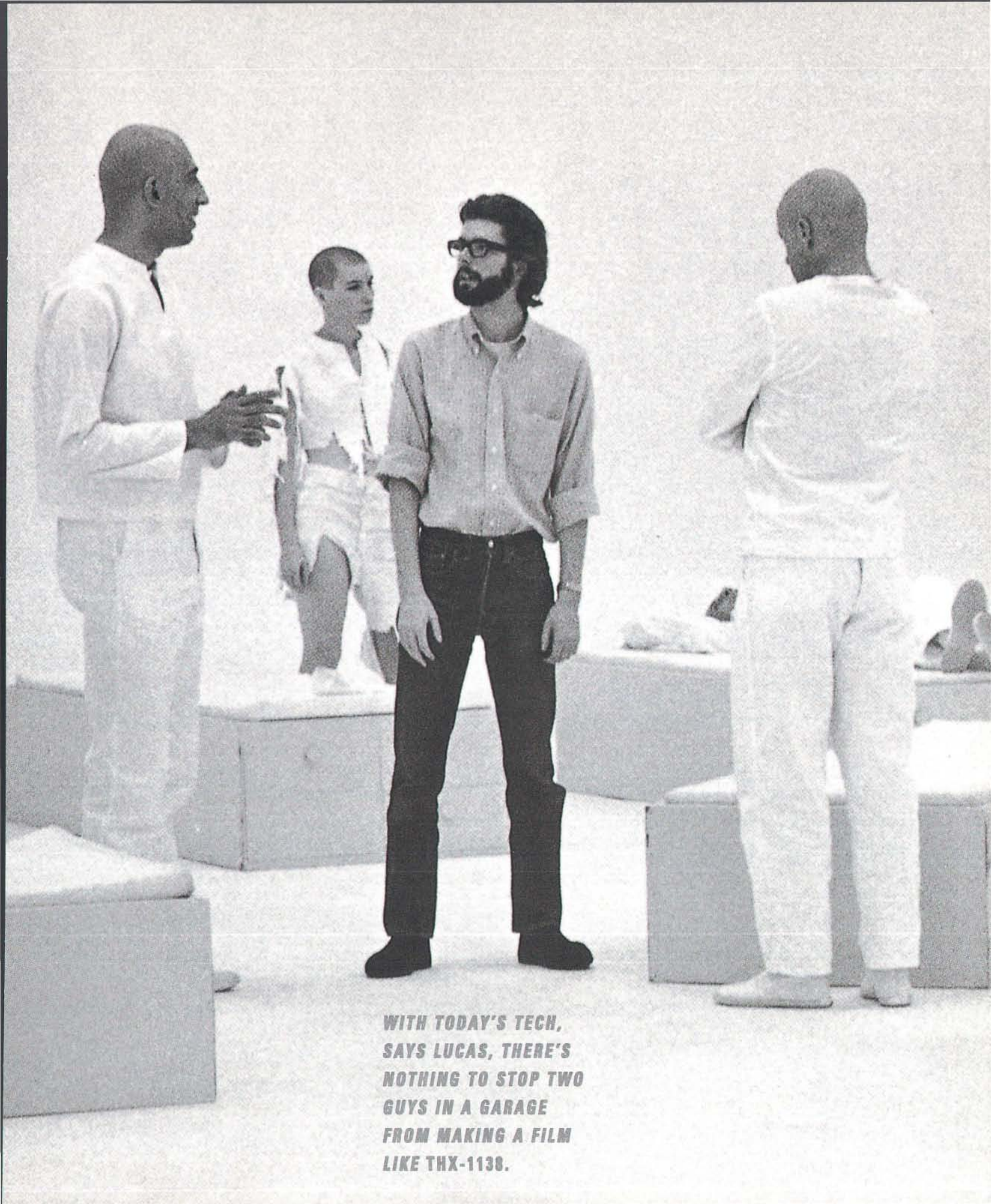
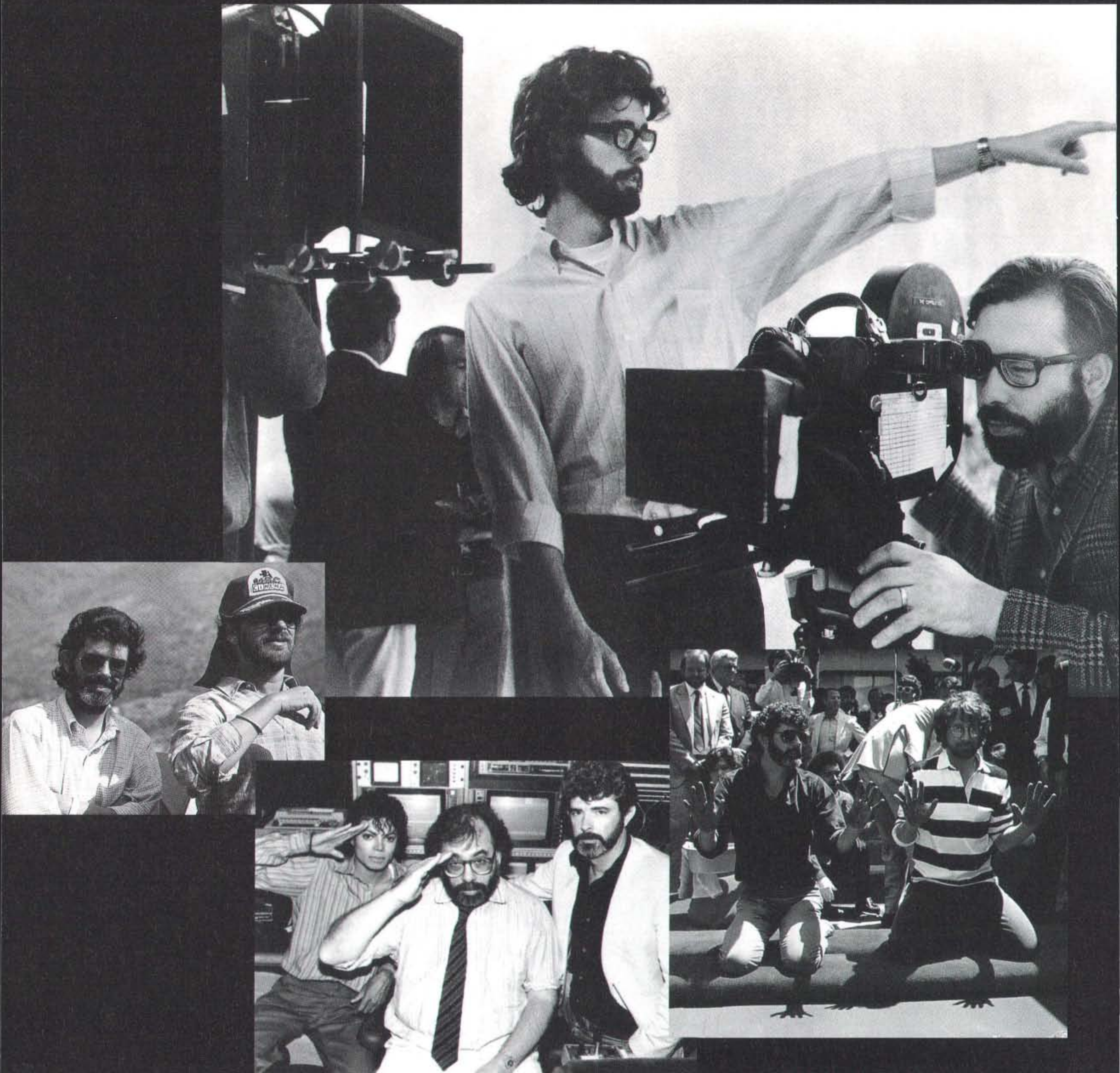
Kevin Kelly (kk@well.com) *is executive editor of* Wired. *Paula Parisi* (pparisi@aol.com) *covers technology for* The Hollywood Reporter*; she wrote about Stanley Kubrick ("The Intelligence Behind* AI*") in* Wired *5.01.*

IMAGE: © LUCASFILM



WITH TODAY'S TECH, SAYS LUCAS, THERE'S NOTHING TO STOP TWO GUYS IN A GARAGE FROM MAKING A FILM LIKE THX-1138.



GODFATHER OF THE DIGITAL ERA: LUCAS WITH FRANCIS COPPOLA, STEVEN SPIELBERG, AND MICHAEL JACKSON.

stand back and look at it and add some more. You basically end up layering the whole thing. Filmmaking by layering means you write, and direct, and edit all at once. It's much more like what you do when you write a story.

How exactly does that change what you do while making a movie?

Everything is different. The actors, the contract, the crew is assembled in a different way. We work a lot in Hi-8 before we get to the actual movie. It's a little more like animation, where you are storyboarding and writing and shooting and editing - all happening all the time. I have been writing [the next *Star Wars* episode] for two years, but I've also been shooting and editing, exploring different kinds of actors for different kinds of parts, and shooting and figuring it out. It's not done sequentially at all. I'll be able to add more things and change more things. Then I can go back and finish shooting. Then as we cut that together, I have already scheduled another three weeks of shooting six months later to add more stuff and change more things, and rewrite it in that period, and then I've got another three months, and then I've got another two weeks of shooting after that. I'm shooting now, and I'll be shooting three years from now.

Sounds like the film is never done!

There is no such thing as "the film." The film is the thing that gets spit out at the very end. Whether I'm doing notes on paper or doing notes electronically, it all comes down to the same thing. Except now I've a very, very clear picture of what it is I'm doing. It's like a painting. You rough it in. You say, Oh, I was going to do this, and then halfway through you change your mind. You can see it evolve; you can sort of be with the work, rather than draw.

That kind of uncertain approach must drive some people in the film industry crazy.

The film business is designed in a kind of industrial way, vaguely the way buildings are built. The architect does the blueprint and turns it over to the contractor. The contractor then follows the instructions, and if nobody is there to say "wait, wait, wait," and if nobody goes in and makes those change orders - which, of course, nobody wants to do because it's very expensive - you end up with a building that's only sort of interesting.

I'm of a carpenter mentality. I have a rough idea of what I want to do, but I'm going to start hammering, and then when I get along here, I'll look at it and say, "We should move this wall here, it would be even better." A lot of Victorian houses were built that way. They weren't built with plans, just by the carpenter saying, "Well, all right, let's measure out the room, it will be 20 feet this way, and it will be 40 feet that way, and when we get the first floor built, we'll figure out what's going to be on the second floor." If you are a good craftsman, you really know what to do, and you understand the structure, you can build a very nice building, but it's very organic. It feels better than something that someone who had a set of plans bolted together.

You take visual notes and some of them - rewritten or not - eventually become part of your film.

The important thing, something Francis [Coppola] taught me, is to go through and do a lot of different layers. He said, "Look, when you write a script, just go as fast as you can. Just get it done. Don't ever read what you've written. Try to get it done in a week or two, then go back and fix it, and then go back through as fast as you can, and then go back and fix it - you just keep fixing it. But if you try to make each page perfect, you'll never get beyond page 10."

Do you think digitalization of film changes things much?

Digital is like saying, "What kind of camera are you going to use? Are you going to use Panavision or an Arriflex? Are you going to write with a pen or on your little laptop?" I mean, it doesn't change anything.

On one hand you are saying digital technology doesn't change much, and on the other hand you are saying it will make a huge difference.

Everyone seems to think that digital technology devoids the medium of content, but that is not true at all. If anything, it broadens the content. There were vast numbers of things you could do in a literary medium that you couldn't even think about doing in a movie. If you said, "There are 10,000 people trudging over the hill," well, to accomplish that in real life is a very, very difficult undertaking. To do a movie like *The Ten Commandments* or *Ben-Hur* would be cost-prohibitive now. But digital technology allows us to do even more. Until this point in film we have been limited to the short story in terms of scope. Digital technology allows us a much larger scope to tell stories that were pretty much the grounds of the literary media.

> "THERE IS NO SUCH THING AS 'THE FILM.' THE FILM IS THE THING THAT GETS SPIT OUT AT THE VERY END. IT'S LIKE A PAINTING. YOU ROUGH IT IN. YOU CHANGE YOUR MIND. YOU SEE IT EVOLVE."

Would you say it is revolutionary?

Digital technology is the same revolution as adding sound to pictures and the same revolution as adding color to pictures. Nothing more and nothing less.

Certainly there must be some issues raised by the fact that these digital layers can be amended later on - by either you or somebody else.

Yes. Digital in film is just like digital in writing. It makes the medium much more malleable; you can

IMAGE (CLOCKWISE FROM TOP): © LUCASFILM; ALAN BERLINER/SHOOTING STAR; GLOBE PHOTOS; KEITH HAMSHERE/LUCASFILM

make a lot more changes. You can cut and paste and move things around and think in a more fluid style – and I love that. We're just getting into that on a grand scale in film. I don't think I'd ever go back to analog. I haven't used an editing machine with film on sprocket holes for almost eight years. I hardly even know how to hold a piece of film anymore – I don't think I could do it. It's just too much work: It's too cumbersome, too slow, and you can't manipulate it enough. It would be like going back and scratching things on rocks!

Are you at all worried about the other consequences of this ease of redoing things? Would you be concerned about someone making Yoda walk long after you're dead and gone?

It doesn't make any difference whether you're digital or analog: somebody can recut your movie and make it completely different than what it is. The issue is artists' rights. In book publishing, usually the artist owns the copyright, and therefore it's impossible for somebody to go back and rewrite the book. But in film, the copyright is owned by a studio, and they can go do whatever they want whenever they want. One of the things that's being pushed through Congress is to try to allow the artist in the film industry to have the same rights that a painter or an author has, which is the way copyright was intended. It wasn't intended for a large corporation to own copyrights; it was intended for the artist to own the copyright. The thing that is problematic in film is who is the artist? Who is the author? Writers claim authorship; the director claims authorship; the producer claims authorship. Ultimately, somebody should be designated the author – not the corporation that owns the copyright that sells it to another corporation that sells it to another corporation. It has nothing really to do with technology.

"IN FILM, THE COPYRIGHT IS OWNED BY LARGE CORPORATIONS. BUT IT WAS INTENDED FOR THE ARTIST TO OWN THE COPYRIGHT. THE PROBLEM IN FILM IS WHO IS THE ARTIST?"

So who do you think should be the author?

I'm not completely sure whether it's the producer, the director, the writer, or all three. It's up to the world to designate an author, because if you say it's the producer, then a lot of directors will become director-producers. That's what I do. I solved the problem by owning my own copyright, so nobody can screw around with my stuff. Nobody can take *Star Wars* and make Yoda walk, because I own it.

What about the temptation to change your own work –

That's what I'm doing! I'm doing that with *Star Wars* right now.

Right, but certain changes may only be pandering to the public at large, or to political correctness.

You know, we didn't have artists' rights in this country until about three years ago. It's my artistic vision. If I want to go back and change it, it's my business, not somebody else's. Somebody bought a Henry Moore sculpture and painted it white – it was a bronze – because it fit better with her backyard. Moore was just absolutely furious. The fact is, in this country you have a right to do that. Well, you shouldn't. If Henry Moore came and said, "I'll paint it white," that's his business because he's the artist. Whoever's name is on the work, whoever's reputation is on the line has the right to alter the work.

That process works really well when you have a world of originals (as in painting and sculpture), but in a world filled with copies (videos, music albums, books), it's a little less clear. It's easy to mess with a copy of something, and should an artist care if I mess with my copy?

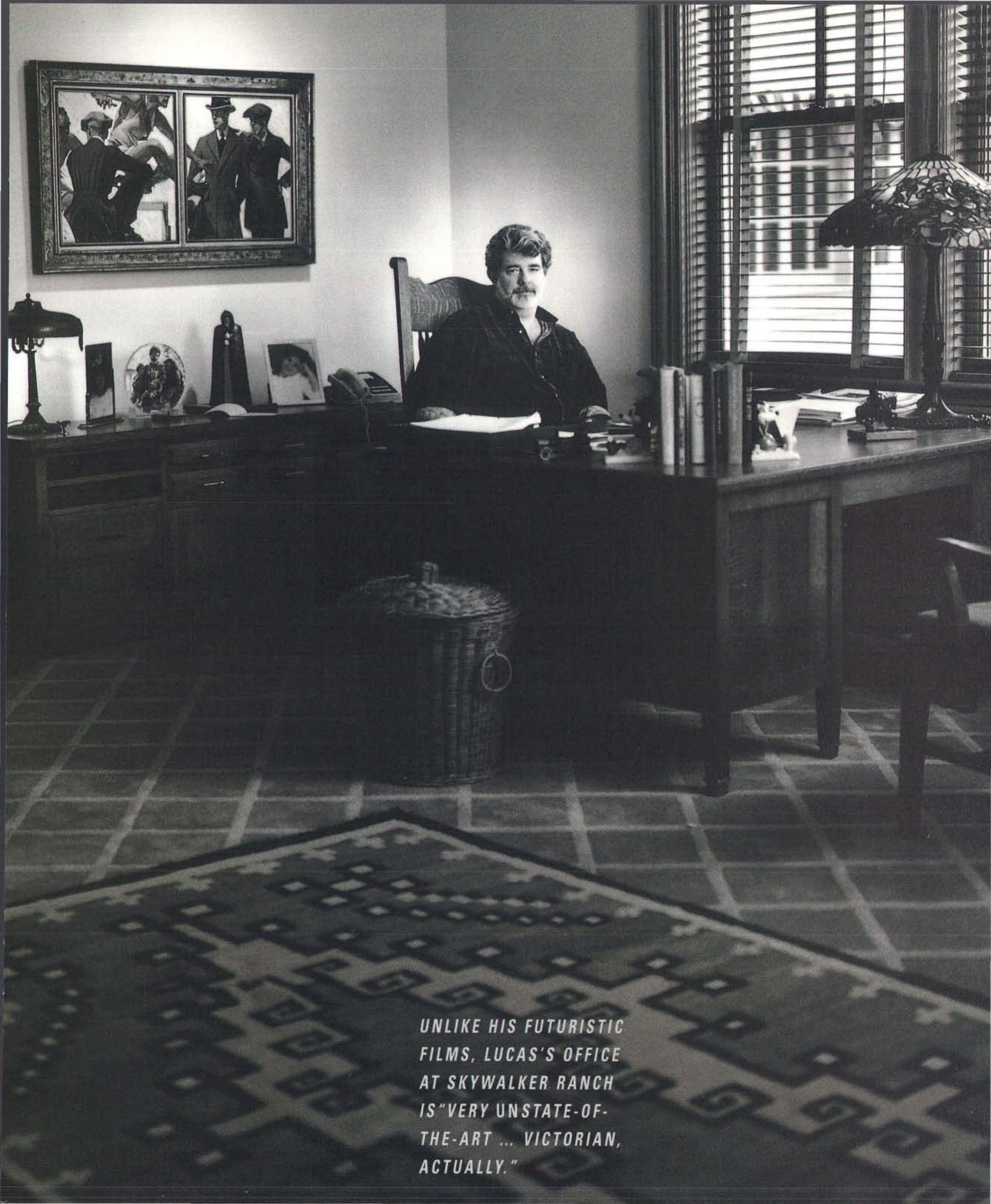
An artist has a legal right to say, "You can't do that." That's how copyright got to be developed in the first place – to protect the artist so that people couldn't exploit his work without him getting something for it. People can take material and then reconfigure it for their own personal needs or turn it into something else. But where you cross the copyright law doing that is an issue that is being debated in court. It's the same issue as somebody taking a famous photograph and then making a sculpture out of it. I mean, who owns the copyright? The guy who took the photograph or the guy who made the sculpture off the photograph?

Some people even claim that the scene the guy photographs and the sculptor re-creates – say, a building or a face – is itself a copyrightable work. Some owners of public buildings won't allow photographers to take a picture of the building without permission.

I'll probably get in trouble for this, but I am an ardent subscriber to the belief that people should own their own image, that you shouldn't be allowed to take anybody's picture without their permission. In the film business, that's the way it is. If I come in here with my Panavision camera, and I take pictures of you guys and then put it in my movie without getting your permission, it's against the law. Now ABC News isn't any more or any less commercial than a Paramount picture, but if I come in here with the same camera, do the same thing, and give it to ABC News, I can do it. My feeling is we should just simply make it all the same: nobody is allowed to use anybody's image unless they give them permission. It's not a matter of freedom of the press, because you can still write about people. You can still tell stories. It just means you can't use their image, and if they want you to use their image, then they'll give you permission.

210 ▶

IMAGE: THOMAS HEINSER



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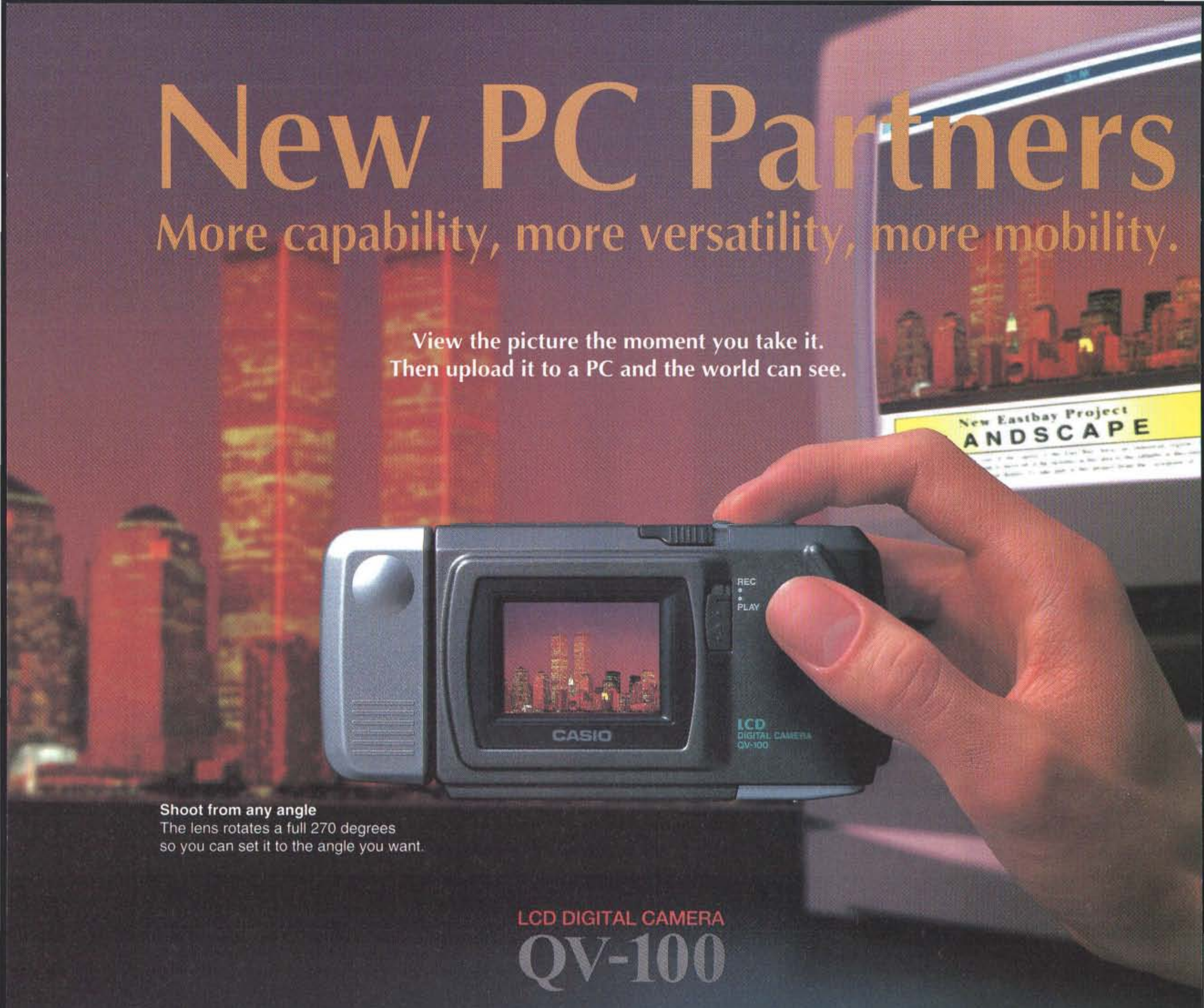

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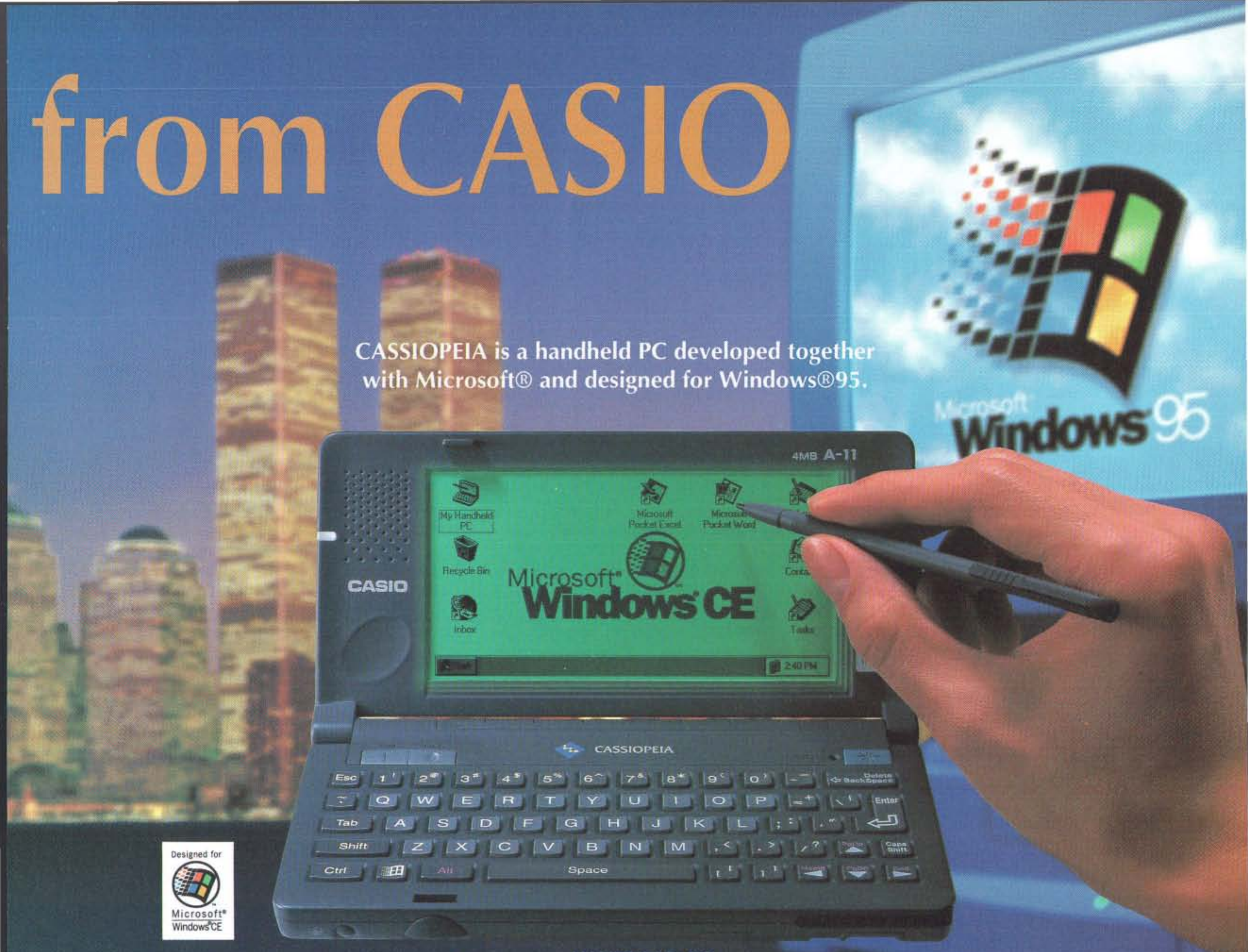

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Atari Daze

If you haven't sold your Atari 2600 at a garage sale yet, you might want to take the game system out of the attic and dust it off. A team of rec.games.video.classic inhabitants has brought 12 Starpath classics back to life.

Released in 1982, these games pushed the 1970s technology to the limit and threw in a funky attitude. The quirky collection includes the shoot-'em-up *Communist Mutants from Outer Space* and *Dragonstomper*, a role-playing game hailed by many Atari fans as the best in its class.

The problem is that these games were originally released on audiotape, which loaded into the Atari 2600 via the Starpath Supercharger adapter. Rather than let these nostalgic bits fade away, Usenet denizens have spent the past two years gathering them for transfer to the more durable audio CD format. (An Atari 2600 and adapter are still required.) In addition to the classics, the CD comes with original artwork, complete instructions, and a few previously unreleased games. Atari 2600 hackers will be pleased to find the first track loaded with PC and Mac tools for the game system.

Supercharge your 2600.

Now, if you seem to have misplaced your Supercharger, good luck finding a new one. Thanks to this long-awaited CD, there's been a run on the market. – *Nick Montfort*

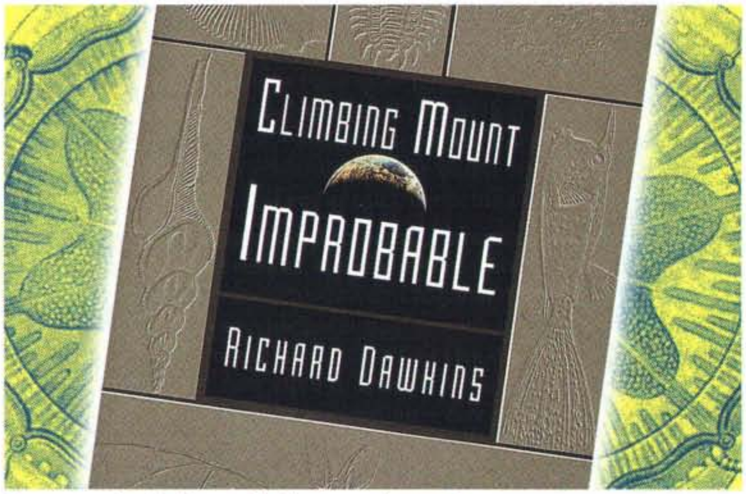
Starpath videogames for the Atari 2600: US$15. Glenn Saunders, PO Box 3127, Glendale, CA 91221-0127.

Dawkinian Evolution

There is a class of great writers whose work settles into a loop, re-orbiting an obsession in tome after tome: Eugene O'Neill, Richard Yates, Tennessee Williams. Nearly every time, they'd give us – with variations here and there – the same troubled households, the same sodden alcoholics. And it was fine. In the hands of a true artist, every revisitation adds a layer of complexity, deepening our involvement and understanding.

Richard Dawkins follows this tradition. His eternal subject is Darwinism, and his obsession seems to be eliminating misguided or even sinister misconceptions about evolution. Dawkins wants us to share his certainty that evolution shaped the form of every single organism on the planet. And so, in each of his books, he presents, with ironclad reason and superb prose, an impassioned defense of the voyager who sailed on the *Beagle*.

In *Climbing Mount Improbable*, Dawkins discusses what may seem to casual observers a chink in evolutionary theory – the fact that many organic phenomena are simply too damned intricate. So intricate that it seems impossible for them to have emerged without some sort of divine engineer who worked everything out on a cosmic blueprint. Here, Dawkins focuses more closely on the kinds of biological magic that seem particularly unlikely to be evolutionary artifacts because they appear to be "all or nothing." Examples include the eye and the ability to fly. An animal either can see, or it can't; likewise an animal either has the body structure and organs to allow it to fly, or it doesn't. So how could evolution, which generally moves by small incremental improvements, come up with something like sight or flight?



A potent cocktail of natural selection and mutation.

Rest assured that Dawkins's explanations are sufficient to convince all but the most intransigent skeptic that evolution's potent cocktail of natural selection and mutation are sufficient to brew up such magic as the human eye or the pigeon in flight. (There's also a boffo section about spider webs.) My guess, though, is that it won't be doubters (and certainly not creationists) who devour *Climbing Mount Improbable*, but those already hooked on the author's ability to present the Darwinian aesthetic with a scientific rigor and an elegance that qualifies as literature. No matter how often Richard Dawkins writes on evolution, it's always worth hearing one more time. – *Steven Levy*

Climbing Mount Improbable, by Richard Dawkins: US$25. W. W. Norton: (800) 233 4830, +1 (717) 346 2029.

Star Hacking

I shuddered when a friend gave me a subscription to *Sky & Telescope*. Nerd that I am, I knew that it would lead to a bad case of telescope fever – the desire to acquire bulky, expensive optics.

Mercifully, I came to my senses before I opted for a 10-inch electronic monster. The reality is that I live in the suburbs near sea level where the seeing isn't great. I needed a scope that offers solid viewing despite streetlight glow and turbulent sea air. I bought a Tele Vue Pronto.

This astonishingly versatile, high-performance refractor functions as both a terrestrial spotting scope and a powerful wide-field astronomical instrument. Optics are of obsessively high quality, yielding 212 line pairs per millimeter of resolution – higher than most telephoto lenses. It magnifies objects in excess of 200 times, powerful enough to view globular clusters and galaxies. The wide-field lens immerses you in the scenery, be it a deep-sky star field or a falcon's perch half a mile away.

Astro nerds' delight!

Pronto is devoid of electronics. Every cent went into optics and beautifully machined design. So, long after that 10-inch technobeast is a relic, my Pronto will be an old and reliable companion. – *Paul Saffo*

Tele Vue Pronto: US$1,395. Tele Vue Optics Inc.: +1 (914) 357 9552.

The Killer Bs

Visionary, an independent video distributor, is best known for its obscure music videos, which chart the territory stretching from Alien Sex Fiend and Link Wray to Johnny Cash. But buried in the back of its catalog, you'll find a selection of B-movie classics, most of which were previously unavailable on video. The most renown is Tod Browning's *Freaks*, the extraordinary 1932 circus film featuring a cast of deformed actors that caused outrage wherever it was shown despite (or perhaps because of) its strong moral message. But dig deeper to find Erle C. Kenton's *Island of Lost Souls* and Edgar G. Ulmer's *Detour*.

In *Island of Lost Souls* (1933) Charles Laughton plays Moreau, a twisted scientist and symbol of colonial oppression who fills his domain with genetically engineered plants and animals he has mutated roughly in the direction of humans. "Do you know what it means to feel like God?" Moreau asks clean-cut hero Edward Parker before trying to fix him up with Lota the panther woman. As sexual and political tensions intertwine, the great buildup is marked by lots of "the natives are restless tonight"-style comments, and eventually the doomed creatures – led by Bela Lugosi in an extraordinary hairpiece – trap the evil Moreau on a ledge before carting him off to his own House of Pain. Fantastic.

Take a *Detour* to the *Island of Lost Souls*.

Detour (1946) is a different kettle of fish. Edgar Ulmer – a set designer and Viennese contemporary of Erich von Stroheim, Fritz Lang, Zoltan Korda, and Billy Wilder – ended up in Hollywood making B movies by choice because of the increased artistic freedom they allowed (he made 128 films in all). A road movie shot in six days inside a Poverty Row studio, *Detour* charts the downfall of Al Roberts (Tom Neal) as he hitchhikes from New York to Los Angeles to join his sweetheart. The accidental death of a guy who gives Roberts a lift leads him to the clutch of Vera (Ann Savage), the most fatale of movie femmes, and the grim existential outcome echoes the unvoiced sentiments of many who returned from the war that year. It also contains one of the greatest of noir exchanges. Al: "Of course, your interest wouldn't be financial would it? You wouldn't want a small percentage of the profits?" Vera: "Well, now that you insist, how can I refuse? A hundred percent'll do." Al: "Fine. I'm relieved. I thought for a moment you were going to take it all." Vera: "I don't want to be a hog." But you will once you see Visionary's eclectic celluloid collection. – *James Flint*

Visionary Communications: +44 (125) 371 2453, fax +44 (125) 371 2362, email *king@visicom.demon.co.uk*. Also available at select video stores.

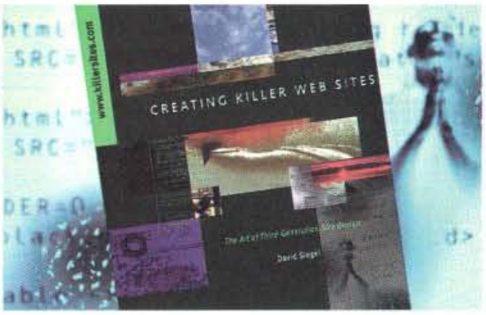
Outta Site

By the time you finish David Siegel's book *Creating Killer Web Sites*, you may suffer the stark realization that your own Web endeavors have been merely first generation.

First-generation sites, in Siegel's words, have "linear displays, a top-to-bottom, left-to-right sequence of text and images, interspersed with carriage returns and other datastream separators, like bullets and horizontal rules." Second-gen sites are not much better, as they "are basically first-generation sites with icons replacing words" and "use a top-down, homepage model to present a hierarchy of information." Not very exciting.

But a third-gen site designer "carefully specifies the position and relationships of all elements on the page, retaining fine control of the layout.... They strive to make a site feel familiar and easy to navigate, with clear typography and high production values."

While *Killer Sites* does a reasonable job in covering a wide variety of Web-related issues – from future formats to PDF to how to keep 'em coming back for more – its primary focus is the *art* of Web design. From contemplating the color cube to touting typography (Siegel trained as a typographer), Siegel delivers an artful, art-full treatise on how to create visually superior Web sites.


www.killersites.com
CREATING KILLER WEB SITES
The Art of Third-Generation Site Design
David Siegel

Guaranteed to blow you away.

The book does a great job describing two tricks for gaining the graphic control necessary to create third-gen sites: the single-pixel GIF trick (used to horizontally and vertically space elements on a page) and the clever use of tables. For these tips alone, the book is worth buying; those of us who've been tossing up first-gen sites will get a clue as to what it takes to do a lot better.

Creating Killer Web Sites may not be the ultimate Web design manual – in part because the Web is changing so quickly, in part because the book has a tendency to skip steps – but for now this book is truly to die for. – *Jordan S. Gruber*

Creating Killer Web Sites: The Art of Third-Generation Site Design, by David Siegel. Hayden Books: (800) 428 5331, +1 (317) 581 3575, on the Web at *www.killersites.com/*.

Comic Science

Science CD-ROMs usually tell you three facts about bear hibernation and then quiz you. Not exactly the way to get kids thinking like scientists. But *Big Science Comics* gets it right.

If you've seen *Snootz Math Trek*, then you've met our round friends the Bumptzes. In this animated adventure, the Bumptzes crash to Earth and need help getting back to their ship. To propel a Bumptz, you have to get one of his fellow critters to jump on the back of a T-square. Too light, and your flying fella will fall short. Too heavy, and he'll hit other objects. The relationships you need to deduce get increasingly complex as you go along. The Bumptzes' good sportsmanship about getting dropped, drop-kicked, and drowned in pie was the favorite part for my fellow product tester, 11-year-old Sasha. "I like it when you get to flick things!" she said. Mo the Packrat takes notes about what you've observed.

Things that go Bumptz.

Big Science Comics is recommended for kids 8 to12. Children on the younger end of that range may need some help here and there. But big folks should remember not to succumb to the temptation to take over – let the kids play, OK? – *Amy Bruckman*

Big Science Comics CD-ROM: US$29.95. Theatrix Interactive: (800) 955 8749, +1 (510) 658 2800, on the Web at *www.theatrix.com/*.

Big Audiophile Dynamite

When audio CDs first came out almost 14 years ago, they sounded harsh and strident. The discs could be particularly grating in the higher frequencies, where cymbals and violins reside. By comparison, good vinyl pressings conveyed a timbral rightness that kept listener fatigue at bay.

In the last 10 years, digital playback has gradually come into its own. CDs are now generally mastered with more know-how; and affordable, good-sounding players by companies such as Rotel, AMC, Marantz, and NAD are giving even pricey turntable/cartridge combinations a run for the money. But perhaps the greatest single advance in digital reproduction to date is Pacific Microsonics' HDCD technology, an encode/decode system that reduces subtle distortions in digital recordings. The process requires that the discs are encoded in HDCD (high-definition compatible digital). Several hundred of these releases now exist, including recordings by Neil Young, Better Than Ezra, and Chris Isaak. Pacific Microsonics says the CDs carry audible improvements over regular versions, a sonic refinement that is apparent even on non-HDCD players. In playback gear equipped with an HDCD chip, however, the encoded discs purportedly really show their stuff. I put the claim to the test with an outboard digital-to-analog converter, the Theta Chroma 396.

Is that a digital-to-analog sound converter – or your new doorstop?

The Theta squeezed information out of my regular CDs that I never knew was there. Especially the bass, which was much firmed up; I felt my heart beat faster with excitement when I heard the extra slam the unit extracted from almost any rock or blues disc I played. HDCD recordings provided additional surprises. Emmylou Harris's heart-wrenching *Wrecking Ball* was as wonderful as ever but rendered with more space and palpability. Comparisons between non-HDCD material and the encoded version of the same recording (try *HDCD Sampler Volume 2*, by Reference Recordings) yielded a better score for the latter every time.

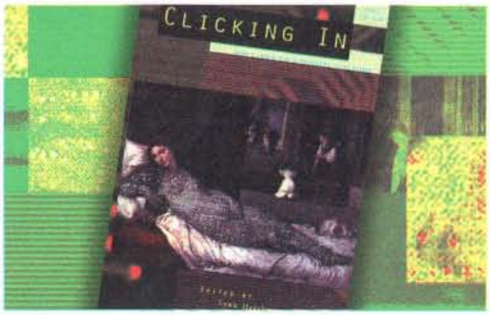
The differences are rarely night-and-day, so they may not matter if you're not that fussy about your sound. But if you have audiophile leanings, the Theta Chroma with the special chip (like other affordable HDCD-equipped units from Adcom, Rotel, and Audio Alchemy) will give you a more intimate perspective of the music. Listen for yourself and be prepared to be amazed. – *Rogier van Bakel*

Theta Chroma 396: US$750; $829 with HDCD chip. Theta Digital Corp.: +1 (818) 597 9195, fax +1 (818) 597 1079. More information about HDCD on the Web at *www.best.com/~hdcd/*.

Culture Warps

Among the growing body of books about the cultural consequences of electronic technology, *Clicking In: Hot Links to a Digital Culture* ranks among the most readable and challenging. Kudos to artist and editor Lynn Hershman Leeson for the volume's intense aesthetic awareness.

The best such an anthology can offer? New perspectives. Latino artist Guillermo Gómez-Peña gets me thinking about computer hardware as altar pieces, ritualistic objects imbued with spiritual magnetism. Art critic Söke Dinkla links today's high tech interactive art to early experiments with border-dissolving audience participation in dadaism and surrealism. And cyberspace researcher Sandy Stone offers the hilarious fantasy of creating a phone-sex robot to make a serious point about the complexity of translating lessons learned in virtual communities to the face-to-face everyday world. There's a great deal of speculative imagining among the various authors, questions raised without a hint of solution. That contributes to the book's freshness.



Mouse optional.

Ironically, the CD-ROM packaged with the book contradicts this sense of open-ended intellectual adventure. It supposedly serves as a "hot link to digital culture," supplementing the text with video clips of several of the book's authors. Writers' videos, in contrast to their writings, depict them as pompous and dogmatic. R. U. Sirius, for example, suffers glibness on the page ("Dying should soon be obsolete for anyone who wants to go on ..."), which becomes more odious when linked to a face drowning in terminal self-importance. Forget the disc. The book alone offers an abundance of revelatory connections to a digital world enhanced by artistic and feminist perspectives. – *Norman Weinstein*

Clicking In: Hot Links to a Digital Culture, edited by Lynn Hershman Leeson: US$24.95 (includes Macintosh- and PC-compatible CD-ROM). Bay Press: +1 (206) 284 5913.

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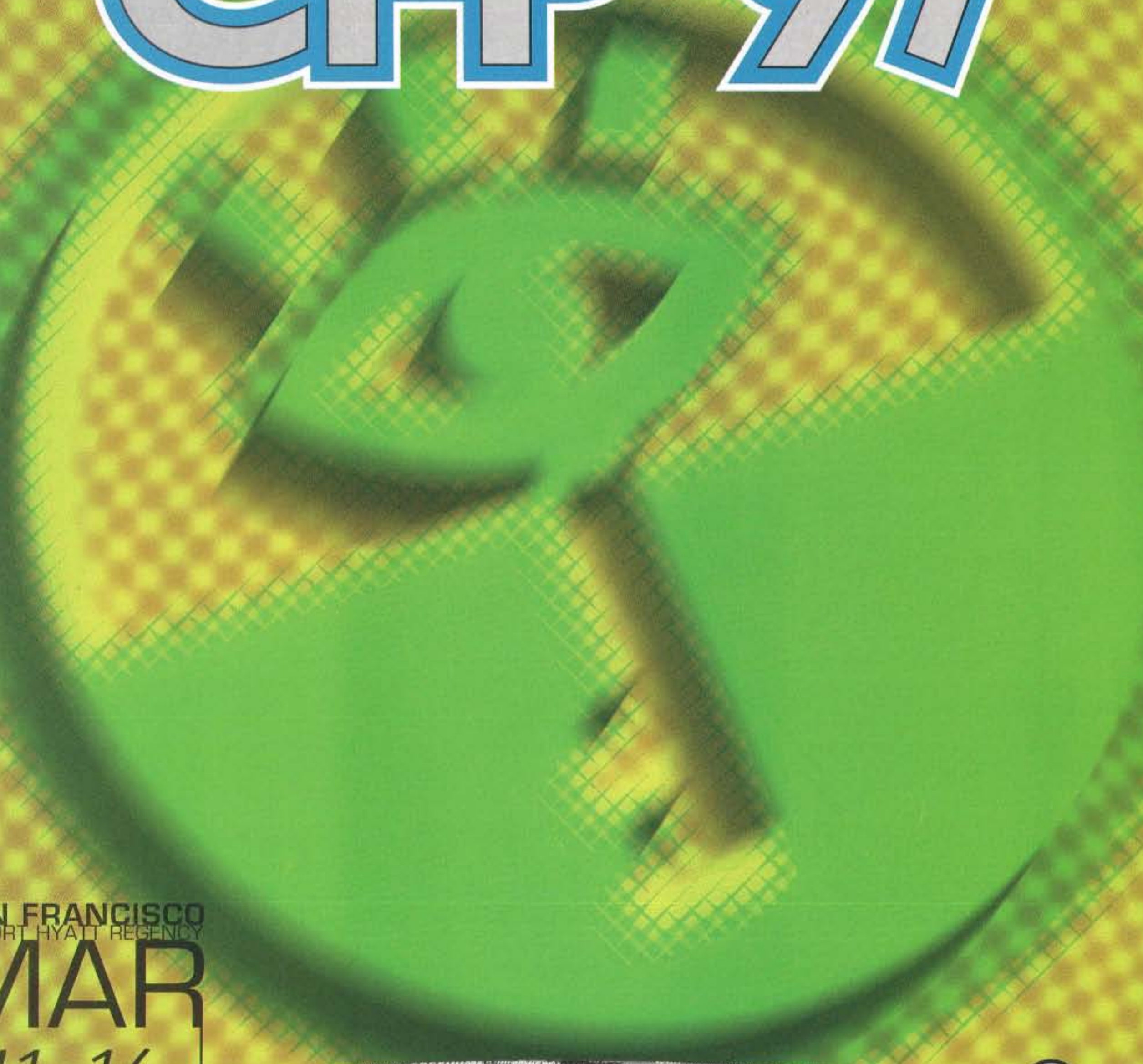

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WHO's predicting the coming **collapse** of the **net**, and why? **Spamming** – who's violating whose rights? How do other countries view the extremes of free expression on the net – and why do we care? Does **cyber-business** threaten freedom and privacy? Who gets to define the **net community**? Are cyberpunks and cybercops finally getting together? What is **critical infrastructure**, and who could be against protecting it? Can states regulate the net? What's needed to **enable commerce** on the net? What's the new wave in intellectual property? What's the theory and practice of net democracy? And what's the latest on **crypto**, **infowar**, and **making money** in cyberspace? Many of the leading – and most interesting – people will be here to tell you. **Join them.**

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Nonproprietary Dialog and Nexis information services are finally interfacing with the Web. While each company has several offerings in the works, Dialog Web will hit the streets soon and will serve up tons more info through your browser – even if you do have to pay for it. *Release: February. Knight-Ridder Information Inc.: +1 (415) 254 8800.*

The Product In his book ***Stuff: The Things the World Is Made Of***, Ivan Amato argues that America may well rise – or fall – depending on the strength of its material scientists. The scientists that build new materials – atom by atom – are a new kind of hero, crafting everything from synthetic diamonds to micromachines. *Release: March. BasicBooks: (800) 331 3761, +1 (212) 207 7000.*

Capitalist Cadre Conceived by the Drucker Foundation – the vanguard of the new economy – ***The Organization of the Future*** pulls together essays by acclaimed visionaries such as Jay Galbraith, Anthony Smith, and Charles Handy who ponder the public, private, and social future of human enterprise. *Release: February. Jossey-Bass Publishers: (800) 956 7739, +1 (415) 433 1740, on the Web at* www.jbp.com/.

Adaptable Tech Seems compact discs are getting better every minute. The CD-RW format allows users to read, write, and rewrite to discs. Whether this assures their future is another matter, but it's nice to know that in storage media at least, you've got some good choices. *Release: March. Philips Electronics N.V.: (800) 235 7373, +1 (408) 453 7373.*

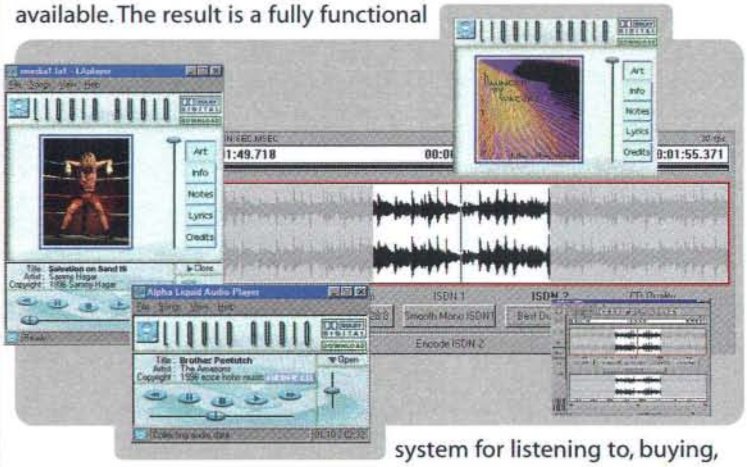
Luke! What does it say in this age of CG when the benchmark of sci-fi films is almost 20 years old and still going strong? Yes, ***Star Wars*** and its successors are back and digitally remastered. *Release: January. Lucasfilm:* www.starwars.com/.

Walkie-Talkie Travel to Cyclone, Arizona, and help a forlorn teen find his missing friends in Sierra's new game, ***Shivers II: Harvest of Souls***. It may sound rather ordinary, but ***Shivers II*** is pumped up by sweeping 360-degree views and an Internet chat feature that dovetails nicely with the company's expanding online game library. *Release: March. Sierra On-Line: (800) 757 7707, +1 (206) 649 9800, on the Web at* www.sierra.com/.

GARAGE BANDS GO GLOBAL

With more pages than your local library, the Web has become the première medium for the dissemination of documents authored by the most obscure individuals. If Liquid Audio, a 30-person Internet software company based in Redwood City, California, has its way, self-publishing will take on a whole new meaning – and medium. Liquid Audio is ramping up a suite of tools and software that will allow mom-and-pop music mongers to preview, distribute, and purchase tunes over the Internet, as well as protect music if it falls into the wrong hands.

Employing proprietary compression tools, the Liquid Audio player and server can stream high fidelity music over the Net. This spring, Liquid Audio will enhance its existing line of music-on-demand products with encryption and watermarking technologies that will secure digitally purchased music. Software that will burn your downloaded songs to CD – assuming you've got a CD-ROM recorder – will also be available. The result is a fully functional system for listening to, buying, and recording music over the Net.



"These technologies are going to bring record stores, music labels, and bands online," says Tom Murphy, Liquid Audio electronic marketing manager. "We're not going to put the record stores out of business, but we will make more music available to more people. By eliminating inventory concerns, we give every indie label and garage band the ability to make its music available for purchase."

But will limited bandwidth stand in the way? It's difficult to say who will be willing to wait for a 50-Mbyte download over a modem or ISDN connection. And will Liquid Audio's watermarking and digital-signature technologies – which can trace but not prevent piracy – placate the copyright concerns of record companies and artists? Similar problems stand in the way of most commercial Net ventures, so it's safe to say that there's a truckload of money to be made in solving them. But while you wait, Liquid Audio could help you make a few bucks off that demo tape you cut in college. – *Jesse Freund*

Release: Spring. Liquid Audio: +1 (415) 562 0880, on the Web at www.liquidaudio.com/.

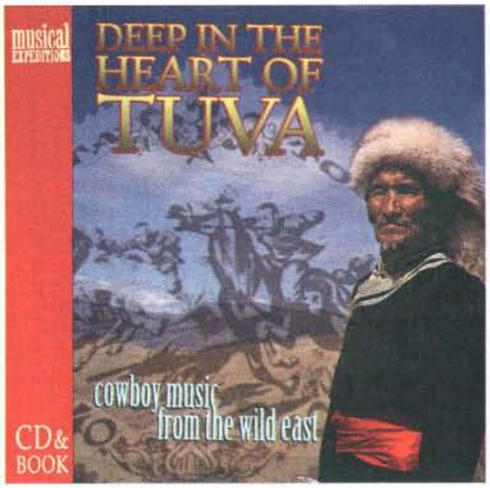
JUST OUTTA BETA

Various Artists

Deep in the Heart of Tuva: Cowboy Music from the Wild East
Ellipsis Arts

Equal parts gazetteer, etiquette manual, and aural anthropology lesson, Ellipsis' Musical Expeditions CD and book series focuses on selections of world musical styles – in this case *höömeï*, Tuvan throat-singing. Oorzhak Khunashtaar-ool (Tuva's foremost höömeïst), Kongar-ool Ondar (who holds the national People's Throat-Singer title), and 15-year-old protégé Shaktar Shulban join a variety of singers who lend their windpipes to the form, accompanied by aboriginal stringed *doshpuluurs*, *igils*, and mouth harps.

It's best to start with Oleg Kuular's demo of the three major throat-singing styles – *sygyt*, a high whistlelike technique; höömeï, a midrange style with melodic overtones; and *kargyraa*, an otherworldly, reedy warble – and examples of their many variations. Hearing these fundamentals allows the listener to trace höömeï's nuances and subtleties in the remaining tracks while reading about the pastimes, traditions, and cuisine of these Central Asian herders.



Some critics will claim the label is commercializing (or at least Americanizing) indigenous music, as the Tuvan release occasionally descends into off-the-cuff descriptions: likening sygyt style to Kermit the Frog, for example, or translating folk lyrics into "Giddyap – we're outta here!" Too, the CD's final tracks, which feature bluesman Paul "Earthquake" Pena punctuating English lyrics with kargyraa while his Tuvan partner adds whistles and trills, suggest that co-opting this ancient form does it little justice.

But as a package, *Deep in the Heart of Tuva* – like Ellipsis' Moroccan, Tibetan, and African Pygmy releases in the series – deserves praise for its design, its cultural concept, and the fascinating music it purveys. The book and CD pique interest in a centuries-old vocal style, one simultaneously risking extinction and exploitation, deserving to remain as unspoiled as the people and land of its birth. In a single höömeï voice, one can hear the whistling wind, the galloping herds, the stark and individual spirit still alive on the Tuvan steppe. – *Colin Berry*

Joe Gallant & Illuminati

The Blues for Allah Project
Knitting Factory Works

The Grateful Dead's flirtation with jazz improv always raised the question of what their tunes would resemble if interpreted by jazz heavies. Here's the answer. Bassist and big-band leader Gallant brought his 20-piece into NYC's Knitting Factory to record this live version of the Dead's *Blues for Allah*. Emphasizing violins, horns, and female vocalists, the result is a dissonant, sprawling tapestry of psychedelically tinged free jazz, infinitely more sophisticated and entertaining than the original set. Certainly not blues, but risk-taking, respectful, and likely to catch Allah's attention. – *Norman Weinstein*

Jaguares

El Equilibrio de los Jaguares
BMG U.S. Latin

Composed of two leading members of the defunct Mexican supergroup Caifanes, Jaguares are more prepared than most foreign bands to attempt a musical incursion into the Northern Hemisphere. As a leading exponent of Latin American *rock en español*, Jaguares' première album yokes indigenous mythology to capable New World pop. The result is a nimble hybrid, dramatically articulated by Saul Hernandez's poetic Spanish lyrics. Jaguares are best heard without preconceptions of *ranchera* or Selena; only then can their songs catalyze the past and present to convey Mexico's animistic history. – *Alan E. Rapp*

Various Artists

Street Jams: Back 2 the Old Skool
Rhino

Straight from the cutout bin and back into your life, this three-volume series resurrects the best of computer-enhanced old-school funk and hip hop. You've heard these tunes before: One Way's "Cutie Pie" is a popular gangsta sample, and Brick's timeless "Dazz" has moved your body at a party or two. What makes this collection exceptional, however, is that it sits squat on the edge of a paradigm shift and, like *Pong* and the Commodore 64, will retool your definition of "classic." Zapp's "Computer Love" sums it up: "I no longer need astrology, thanks to my technology." – *Shauna Sampson*

Swans

Soundtracks for the Blind
Young God/Atavistic

After 15 years of making uncompromising music, the Swans bid us farewell with a recording of Homeric magnitude. Intense sonic assaults jut against gentle instrumentals; tape loops mesh raw feedback with the lost conversations of dead souls; samples are tucked between carvings of art and language. In 1950, Hinsie and Shatsky wrote: "Autistic material … appear[s] as daydreams, phantasies, delusions, hallucinations, etc. In classical instances, such as occurs in schizophrenia, the unconscious sphere makes the largest contribution." This is the Swans' last studio album. Behold the daydream nation. – *Mitch Myers*

Various Artists

Pure Abstrakt
Shadow

First to break Tokyo's DJ Krush in America, Shadow Records has just released this sampler featuring two cuts from each of seven experimental hip hop acts falling under its aegis. Sometimes called *headz* music, the label's tranquil, communal style is largely instrumental and more daydreamy than nightmarish. Da Germ's "Physical Chemistry" features a strolling breakbeat; the zooming bass and spritely flute of obO's "Piked" suggest a contented Gil Scott-Heron; Otropic T(h)ree's "Proud Mamas" interweaves hypnotic rhythms with life-affirming sounds of a playground. There's music here for all moods. – *James Sullivan*

The Sabri Brothers

Ya Mustapha
Xenophile

You haven't heard singing until you've heard *Qawwali* – hypnotic, powerful, and trance-inducing Sufi praise-singing. It is the sound of joy, of religious rapture. On their new disc, The Sabri Brothers maintain their traditional sound, but they're not afraid to experiment. Producer Richard Blair (who's worked with another Qawwali master, Nusrat Fateh Ali Khan) has opened the Sabri sound in places. Along with the usual voice, drums, and harmonium arrangements, you'll hear touches of sax and electric bass. Still, the core of Qawwali hasn't changed a bit, remaining as steady as the beat and passion the Sabris bring to their music. – *Richard Kadrey*

Lori Carson

Everything I Touch Runs Wild
Restless

Known for her work with the Golden Palominos, Lori Carson stirs a sinuous blend of acoustic sensitivity and lush ambient textures into her third solo album. Playing a lone guitar or accompanied by slow, grooving beats, Carson's lilting voice hits the heartstrings with honesty and intimacy. Though sparse and melancholy at first, her songs bloom into sensual illuminations of lost loves or greener tomorrows. From the delicate, poplike "Souvenir" to the confessional "Black Thumb" to the soothing, danceable "Something's Got Me," Carson's music is compelling, flowing, and always refreshing. – *Roger Park*

Terminus Gare de L'Est

Cabaret Russe
ARB/Qualiton

This Polish-born and Paris-based duo of Marian Kurcab (accordion) and Marek Czerniawski (violin and vocals) blazes through a program of traditional Russian Gypsy tunes with an exhilarating postpunk energy. They bring new life to the weepy chestnut "Daroga Dlinnaya" – which was the source of the schmaltzy pop hit "Those Were the Days" – and turn in an appropriately hopeless reading of "Otchi Tchorniye," one of the saddest unrequited-love songs ever written. Khatchatourian's whirlwind "Saber Dance" lets the duo (and an uncredited bassist) show off their manual dexterity. – *j. poet*

YOU WANT A PIECE OF ME PROGRAM BOY?

Go ahead. Hit me with your best shot. But be forewarned. You've got to be a damn good programmer to work on **Final Fantasy® VII for Windows® 95.** It's simply the hottest role-playing game going. And we intend to keep it that way. We've got more mind-altering stuff in the works, too. Games that make mere mortal programmers weak in the knees. But, hey, if you really think you've got what it takes, send us your resume. You just might get a shot at the title.

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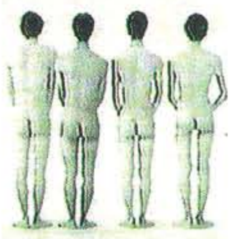
Eyeless in Ginza

Author Yukio Mishima once said that being a gay man in Japan was no big deal – if you knew how to play the game. You could sleep with all the boys you wanted, as long as you also got married.

In 1969, writer/director Toshio Matsumoto broke that tradition with the release of *Funeral Procession of Roses*. This is a look not just at late '60s Japanese gay life but at the guys who couldn't fake it. The story revolves around the rivalry between a young upstart drag hostess, Eddie, and a senior barmaid, Madame, over who will win the heart of a bar owner and become the star of his club.

Taking a cue from Cocteau, who filmed a surreal version of *Orpheus*, Matsumoto loosely based *Funeral Procession of Roses* on *Oedipus Rex*. He also dips liberally into techniques from French new wave directors like Truffaut and Godard. His story unfolds in an elliptical, nonlinear way, sometimes halting to interview an actor in the movie.

The film glimpses a Japan outsiders rarely see. Like the US, Japanese society in the late 1960s reveled in drugs, free sexual play, and protests. For all its period strangeness and art house tics, there's a familiarity to the characters' lives and conflicts. Matsumoto finds universal conflicts in a story about a very specific culture. – *Richard Kadrey*



A view to the rear.

Funeral Procession of Roses: US$25. Video Search of Miami: +1 (305) 279 9773.

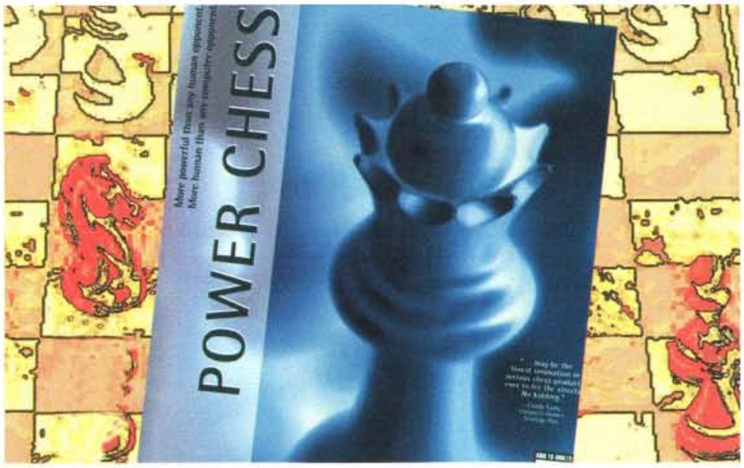
Shall We Play a Game?

When it comes to chess, I'm no slouch. No sir. I'm an absolute loser. I know this because *Power Chess* (in a kind way) told me so.

Over the past several weeks, I have cultivated a base hatred for the way this computer game dangles victory in front of me and then snatches it away in four, final, cataclysmic moves. The game's designer tells me he made it that way on purpose. What a *jerk*.

Yet, this game is great. It is one of the best things to happen to onscreen chess since there was such a thing. At once a game, a tutorial, and a power player's exercise program, it is based on the WChess Artificial Intelligence Engine, which emerged victorious in the Fifth Harvard Cup Human versus Computer Intel Chess Challenge and fought the infamous Deep Blue to a draw.

Whether you're a beginner or a chess enthusiast (or a garden-variety loser; see above), *Power Chess* has something for you. The hostess, the Chess Queen, is a clear-voiced presence that tutors and offers real-time commentary on both live matches and reenactments of some of the great games of all time, including the Kasparov-versus-Deep Blue confrontation. The chessboards and pieces are texture-mapped 3-D models, viewable from any angle. A number of striking sets can be selected, including a classic set, an abstract ethnic design, and even an industrial group composed of polished nuts and bolts.


POWER CHESS
More powerful than any human opponent. More human than any computer opponent.

"I'm a loser, baby. So why don't you checkmate me?"

The program studies players' habits and never falls for the same trick twice. If an advanced player is wildly outclassing *Power Chess*, it will get smarter and meaner, cattle-prodding the player along; if the player is getting stomped, it will ease off (but only the weensiest bit). It continually adjusts and tests, observes and corrects, keeping the player just at the rim of his or her ability.

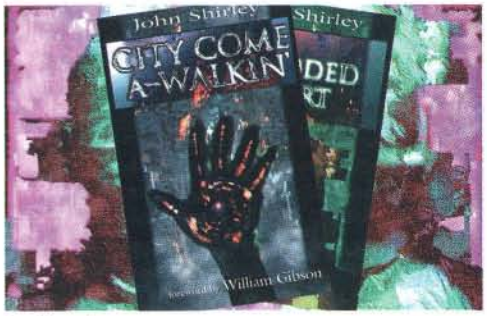
Seriously psychotic chess enthusiasts can use the automatic move notation system to save and print game charts of opening gambits, variations, and the like for their notebook, a play log that every real chess freak keeps. Players seeking human opponents on the Net need only jump to the Sierra Web site to enter the Power Chess Tournament Hall. *– Chris Hudak*

Power Chess for Windows: US$39.95. Sierra On-Line Inc.: +1 (206) 649 9800, fax +1 (206) 641 7617, on the Web at *www.sierra.com/*.

Cyberpunk's Patient Zero

In the introduction to this new edition of *City Come A-Walkin'*, William Gibson calls John Shirley "cyberpunk's Patient Zero." Reckless, rude, and raw-edged, Shirley had the 'tude before anyone; he also walked the walk. In the darkly exuberant *City Come A-Walkin'*, published four years before *Neuromancer* and long out of print, cyberpunk was already in full riotous bloom. Now Shirley has taken a swipe at polishing the sometimes rushed and awkward prose of the first edition, giving everything a sheen to match the beautiful trade-paper packaging provided by Eyeball Books. An essential addition to the libraries of cyberpunk historians, *City's* appeal is much more than academic.

Science fiction – and especially cyberpunk – often views humanity in terms of its cities. The metropolis is a perfect dramatic backdrop, a microcosm that permits us to view the collision of culture and technology at the very point of impact. In Shirley's novel, the city is not only the setting but also the protagonist: San Francisco has come to life in the form of a punked-out golem, determined to "take back the streets" from violent forces that have rotted it from within. The campaign is violent. Like most of the cyberpunk writers who came after him, Shirley has all but eliminated pastoral images from his fiction: the closest thing to paradise is the reclaimed urban wilderness left behind after the tyrants have been clobbered and the buildings have burned themselves out.



Darkly exuberant.

For more in the same rich vein, check out Shirley's book *The Exploded Heart*, a collection of about a dozen of his most effective short stories, along with an introduction by Bruce Sterling, some new autobiographical material, and the lyrics to Shirley's Blue Oyster Cult songs. While Shirley scales the heights of delirious paranoid fantasy in his novels, it is in his shorter work that he's at his most polished and controlled. Some of these stories read like crystallized nightmares; others are pure electricity. If Eyeball would now put out a definitive collection of Shirley's best "new noir" and horror stories, my bookshelves would groan with contentment. *– Marc Laidlaw*

City Come A-Walkin' and *The Exploded Heart*, by John Shirley: US$10 each. Eyeball Books: PO Box 18539, Asheville, North Carolina 28814, email *eyebrown@interpath.com*, on the Web at *www.empathy.com/eyeball/eyeball.html*.

Fin-Finnicky

On morningbreak, a blue dolphin-bird named Fin-Fin sleeps on his favorite branch in the Tsubu woods. His eyes and ears – a combination motion detector and microphone perched atop my computer – perk up as footsteps approach, and Fin-Fin wakes onscreen to direct his watery blue eyes my way.

More than other computer pets on the market, Fin-Fin is an independent entity. You can entice him to do tricks by offering berries or talking sweetly to him. You can also drive him to tears by yelling or ignoring him. He reacts not only to the sounds and movements of the people around him, but also to his environment on the Magic Planet. He wanders off when hungry and sulks a little when it starts to rain. Over time, he exhibits new behaviors, like singing songs and performing acrobatics.

No bird brain.

Fin-Fin, according to Fujitsu Interactive, is designed to teach children 4 through 12 a sense of concern for the environment and the challenges of building relationships. These goals add to both the charm and frustration of Fin-Fin. If you don't play with him, he becomes shy and sullen, and it takes a while before he warms up to you again. Even when he's happy, he sometimes wanders off. From a cat you expect this kind of behavior. From your computer, it can be downright disconcerting.
– Dave Thau

Fin-Fin on Teo, the Magic Planet: US$39.99. Fujistu Interactive Inc.: +1 (415) 538 2900, on the Web at *teo-world.com/*.

README *On the bookshelves of the digerati*

STEWART BAKER, *once the general counsel for the NSA, specializes in high tech law. When he finishes a book, he either gives it away or throws it away.* "I went on a binge of poetry by **Sharon Olds** – ***The Dead and the Living, The Gold Cell***, and ***The Wellspring***. These books left me stunned like a steer on a killing line. You cannot read the first line without wanting to read the rest of the poem: 'After they go away to summer camp, I am alone in the house in the early evening....' That just pulls you in. It's extraordinarily autobiographical and devastatingly honest about her family relationships. So much poetry is written about love and so little about the relationship between parents and children – this speaks to a whole other area of experience."

***William Cooper's Town: Power and Persuasion on the Frontier of the Early American Republic,* by Alan Taylor.** "This is a history of Cooperstown; a history of the dispossession of the Indians and then dispossession of the Tories. It gives a different perspective on the American Revolution to read about colonial soldiers bayoneting Tory children. We don't think of our revolution as having inspired that kind of blood lust."

LINDA JACOBSON *is the virtual reality evangelist at Silicon Graphics and the cofounder of VeRGe, a group for technophobes and technophiles alike.*
***The Secret Language of the Mind: A Visual Inquiry into the Mysteries of Consciousness,* by David Cohen.** "Whew! This is truly a gorgeous book – well-written, with mind-bending illustrations. I'm fascinated by brain science, by how we perceive, remember, and experience the world around us ... which has everything to do with creating effective virtual reality applications and technologies."

Stewart Baker

Linda Jacobson

Douglas Rushkoff

"Late at night, I'm reading a fast, fun novel called ***The Bestseller***, by **Olivia Goldsmith**, a fictionalized account of the book publishing business. Goldsmith dishes factual dirt about Manhattan-based book people and draws some great characters and snappy dialog. Overall, the passions these characters have for their own writing makes me want to write another book. But it's such a backbiting industry. It's about who you know and what your publisher had for breakfast that morning."

DOUGLAS RUSHKOFF, *author of too many books to list here, writes about the relationship between technology, media, and culture.*
***White Noise,* by Don DeLillo.** "DeLillo may just be the best American novelist around these days. I particularly like the way he makes pop cultural references without making pop cultural references. He just thinks and writes from that place between a character's awareness and the world in which that character lives. It makes for terrifically funny, dark comedy. In one scene, two cultural studies profs do a comparison of Elvis Presley and Adolf Hitler that is both absolutely inane and sheer genius."
***Neuro-Linguistic Programming, Volume 1: The Study of the Structure of Subjective Experience,* by Robert Dilts, John Grinder, Richard Bandler, and Judith DeLozier.** "What interests me most about neurolinguistic programming is the attempt to break down and define human thought and behavior. People as robots. They figure out which way you glance when you're thinking about the past, say, or an emotional experience, and then use this information to help or manipulate you."

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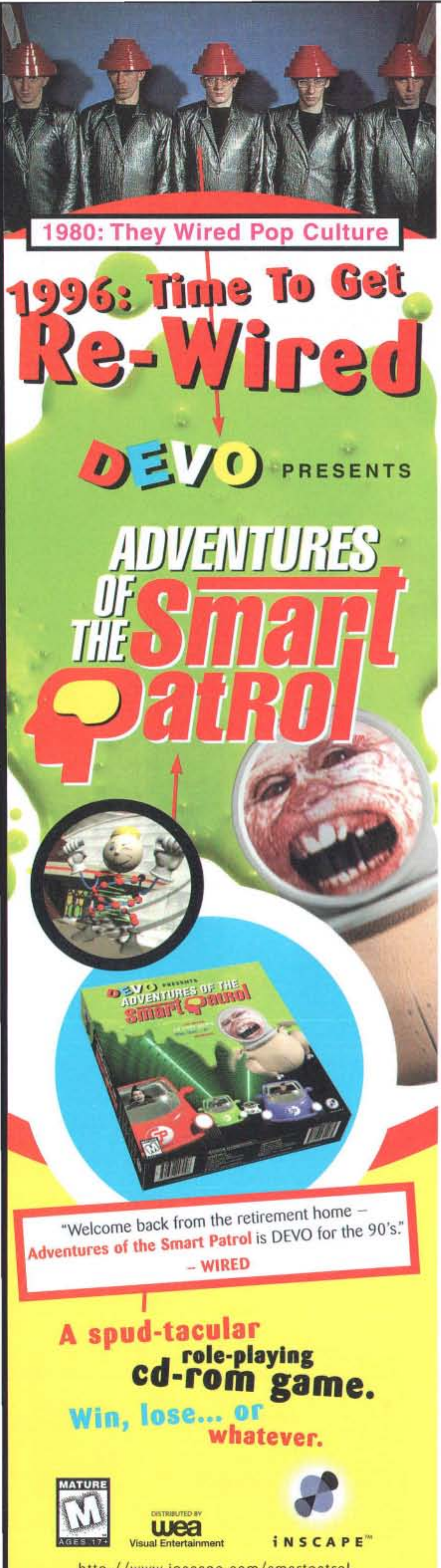

1980: They Wired Pop Culture
1996: Time To Get Re-Wired
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1. Smartcard Privacy

If you need a lesson on how the technologies of freedom can become the tools of oppression, take a look at smartcards. Years ago, crypto maverick David Chaum almost single-handedly developed the algorithms needed to make digicash possible, and he made sure they provided anonymity without sacrificing security or accountability. Now, as the hype surrounding smartcards grows, Chaum's work is being steadily perverted. Few of the new commercial schemes provide anonymity; worse, some seem poised to become a new kind of identity card. Forget the Clipper Chip: these devices will be the real "Big Brother inside."

2. Caretaker Organizations

I never feel as cared for as when I'm online. In the area of securities fraud alone, there are sites from the SEC *(www.sec.gov/)*, the National Fraud Information Center *(www.fraud.org/)*, and NASD Regulation Inc. *(www.nasdr.com/)* to help guard against online con men. The only problem is that a quick spin around the Web turns up far more caretaker organizations – from eTRUST to SurfWatch – than it does grifters. Everyone is so busy offering "good housekeeping seals" that no one has time to do anything worth protecting people from.

This Month's Overhyped Memes	Hype Level	Position Last Month	Expected Lifetime
Smartcard Privacy	↑	↑	**4 months**
Caretaker Organizations	↑	○	**6 months**
Virtual LANs	↑	↑	**12 months**
Parody Web Sites	☁	🔥	**3 months**
Network Computers	☁	🔥	**4 months**

○ = Embryonic meme ↑ = Meme on the rise 🔥 = Mass-media meme ☁ = About to die from overexposure

HYPE LIST

3. Virtual LANs

The hottest concept in networking is based on a surprisingly straightforward idea. Why not allow administrators to partition networks into small, logically distinct "virtual LANs"? This way, proponents argue, people who work together can be on the same VLAN, regardless of where they are located on the network. The problem is that few applications broadcast data to everyone in a work group, so VLANs don't do much to reduce network traffic. And without a VLAN standard on the horizon, administrators are only creating a giant headache for themselves.

4. Parody Web Sites

Perhaps it started last year, when the Web sites that parodied the presidential candidates' homepages got more publicity than the real ones. Or maybe it was when *Stale* was greeted with more accolades than Michael Kinsley's *Slate*. Whatever the case, parody sites have become inescapable. Pundits dispute why this kind of humor was so quick to take over, but all their theories seem to boil down to the same thing: the only thing worth discussing on the Web is the Web.

5. Network Computers

Network computers remind me of those clunky wordprocessors from the early 1980s. A cheap computer dressed up as a traditional typewriter, it was marketed to technology-weary consumers. But due to the device's tiny screen, limited data storage, and lack of flexibility, it quickly disappeared from the marketplace. NCs simply repeat these mistakes. Which begs the question: If NCs are such a dumb idea, why do Scott McNealy and Larry Ellison believe in them so fiercely? Answer: Because these are the same guys who believed in video-on-demand.

– *Steve G. Steinberg* (hype-list@wired.com)

The Quiet Zone

Sometimes, you want to block out annoying noises. When you can't leave a boisterous room or airplane cabin, the Koss Quiet Zone 2000 headphones are what you need. Koss uses "active noise reduction" circuitry to detect a constant external noise and then create an opposite, out-of-phase wave, which, in theory, cancels out that irritating sound.

Pilots have worn this type of headphone for years, but they cost US$1,000 or more. I've tried the lower-priced Koss units on walks in my neighborhood and sitting at sidewalk cafés. They cut out half the rumble of a bus or the buzz of traffic, chopping off the low end and leaving only the higher frequencies.

The high-quality headphones can also be used to listen to music and audio recordings and have good, full-frequency response. Nothing in the circuitry cuts out any of the music's low end, which is decent for small, open-ear models, and the highs are bright and crisp – but not artificially so. When you switch the noise unit on while music is playing, you'll notice a slight change in the sound – the music becomes somewhat lighter and airier in balance, and the background noise recedes, even at low volumes. You can listen to recordings at a lower setting, protecting your ears from damage while protecting your sanity from the nonstop roar of a leaf blower or other annoyances. – *Chris Rubin*

Hush.

Koss Quiet Zone 2000 Headphones: US$199.99. Koss Corporation: (800) 872 5677, +1 (414) 964 5000, on the Web at *www.koss.com/*.

Street Cred Contributors

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Richard Kadrey *(kadrey@well.com)* is the author of the *Covert Culture Sourcebook* and two novels: *Metrophage* and *Kamikaze L'Amour*. He has no qualifications for anything he does.

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j. poet *(poebeat@aol.com)* writes for *RhythmMusic*, *Utne Reader*, and many other fine publications. He is looking for a cheap, noncorporate online service.

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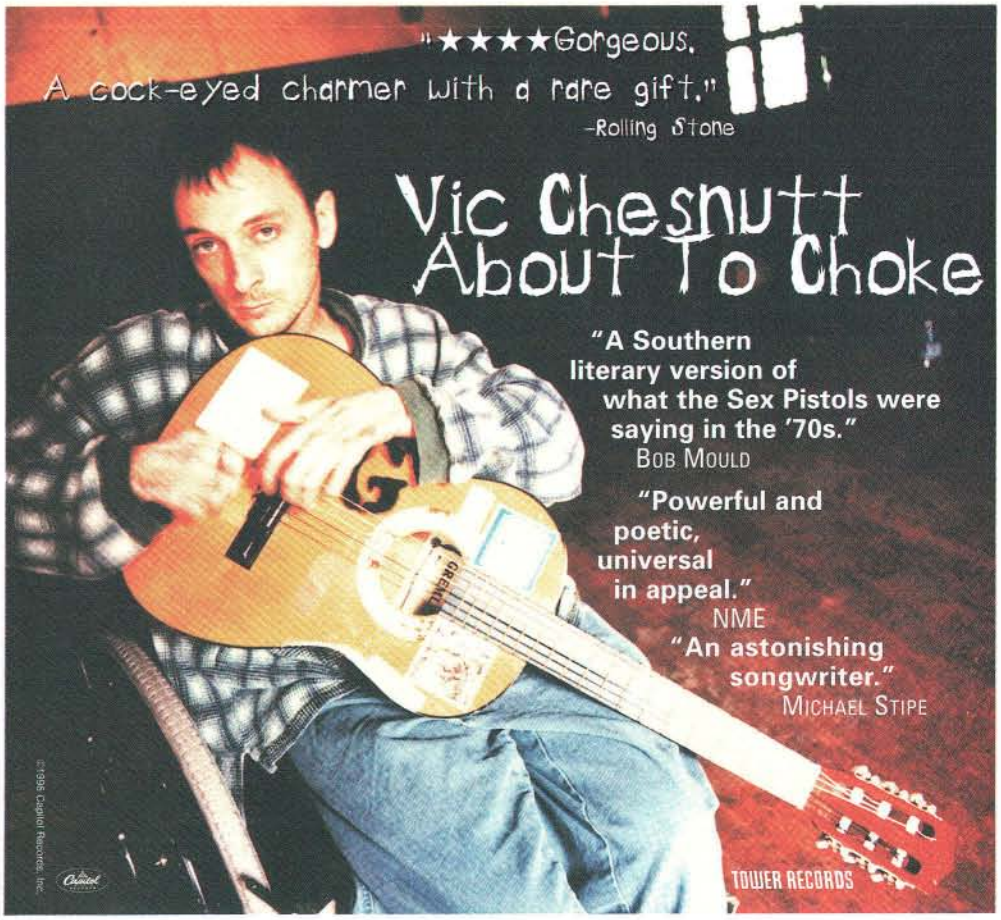
James Sullivan *(onion65@aol.com)* is a regular contributor to a whole bunch of pop culture periodicals.

Dave Thau is a lover of dolphin-fish, director of software engineering at HotWired, and one of the core trolls at Bianca Troll's Smut Shack *(www.bianca.com/)*.

Rogier van Bakel *(rogiernl@aol.com)*, as anagram enthusiasts will note, has Brave Ink Galore. He lives in Connecticut.

Norman Weinstein writes reviews for *Wired*, *Pulse!*, and *Monitor Radio* on NPR. He is writing a book about the physics and metaphysics of light in Frederic Church's paintings.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Vic Chesnutt
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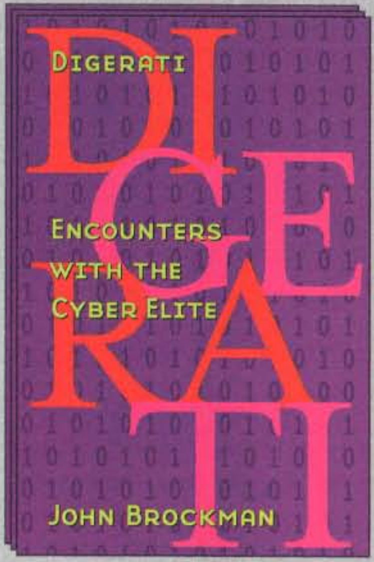
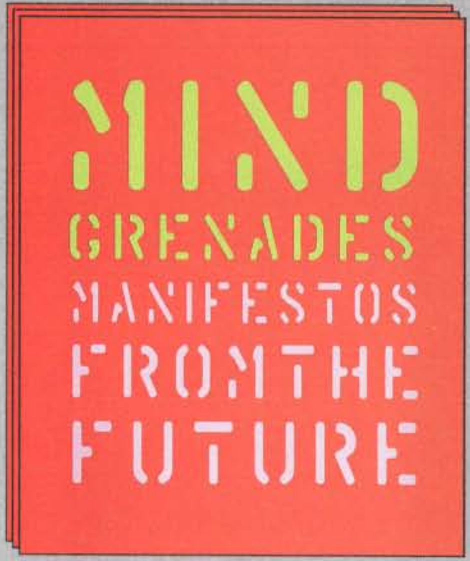


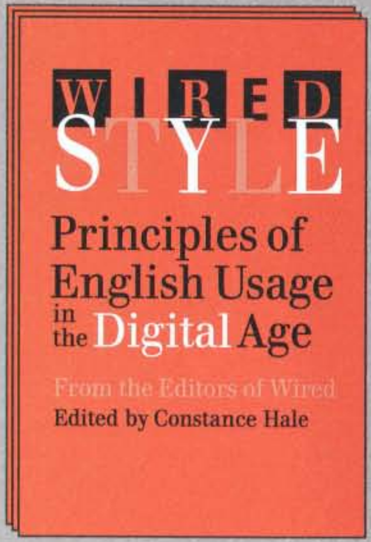
"A natural salonkeeper and provocateur, Brockman rubs heads together until they produce heat and light."

Stewart Brand, author of *The Media Lab*



"This book will exercise both sides of your brain. An incredible collection of thought-provoking picture bites of a digital civilization."

Nicholas Negroponte, author of *Being Digital*


WIRED STYLE
Principles of English Usage in the Digital Age
From the Editors of Wired
Edited by Constance Hale

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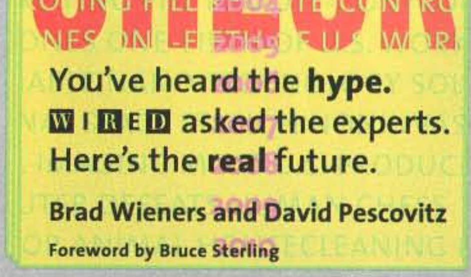

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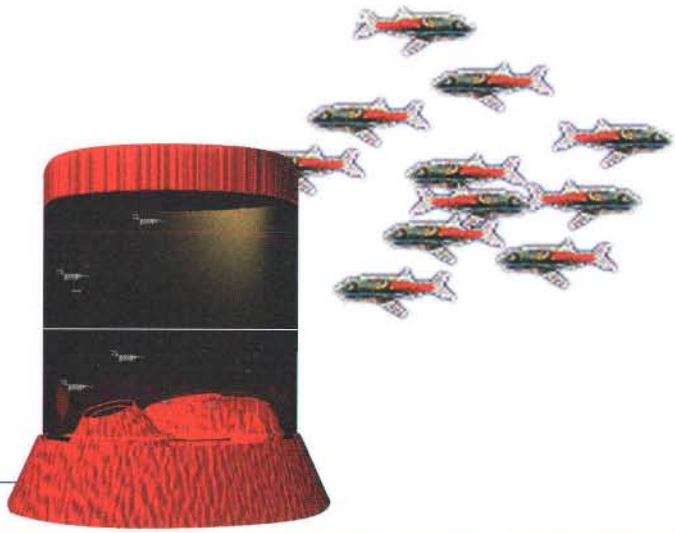
Digital Darwinism: Natural Selection on the Web

Remember sea monkeys? They came in packets like those spices for instant ramen noodles. Poured into a plastic aquarium and mixed with water, they would sprout into families of smiling, aquatic simians. At least that's what the ads on the back pages of comic books claimed.

While you may have lost a bit of your childhood innocence when you realized your little floating friends were nothing but tiny brine shrimp that die in a matter of days, the sea monkeys live indefinitely at *k2.scl.cwru.edu/~gaunt/java/SeaMonkeys/SeaMonkeys.html* (you may need Netscape 3.0). This site demonstrates a basic artificial life system, even though the interactive quotient is a bit low.

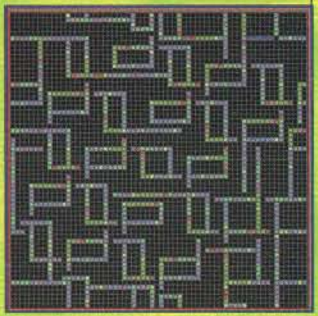


Still, the above exemplifies how online a-life systems work throughout the Net. They function as virtual ponds where artificial intelligence thingies squirm and thrive. The educational possibilities are obvious, but alas: though interactivity is generally a key component to the user's experience of such an environment, these net.aquariums are best appreciated as more refined versions of sea monkeys – diversions from the everyday humdrum of the Web.

***Amazing Fishtank Safari* *(morganmedia.com/m2/shock.html)* goes a couple of steps further with a real-time fish-sim. On this Shockwave-generated site, you create your own fishies and release them into a tank. Watch as your more aggressive, carnivorous creations mercilessly chomp down their weaker brethren. It's digital Darwinism at its very best.**

Advancing up the evolutionary ladder of a-life sophistication, simulated cells can be seen at *ourworld.compuserve.com/homepages/cdosborn*. These loops of "cellular automata" swirl as they reproduce according to parameters you set, leaving multicolored trails in their breeding wake. The mesmerizing result is akin to watching cells under a microscope as they form kaleidoscopic patterns.

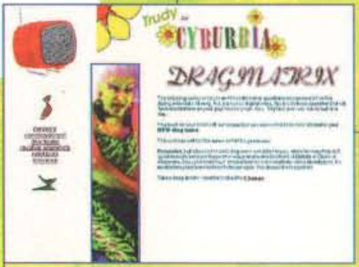
Located in Hiroshima, Japan, the *ALife Garden* *(www.cisnet.or.jp/~alifeg/)*, as the name implies, develops and nurtures scores of a-life species. This site is a highly developed evolutionary pool harboring brightly colored, jellyfish-like creatures that evolve in real time. ALife Garden offers more than just elaborate, VRML-driven creatures when it comes to interactivity. And the results are more immediate: the beauty that blooms here is both serene and elegant.



Think of *The Live Artificial Life Page* *(www.fusebox.com/cb/alife.html)* as a kind of pet store where multiple a-life aquariums are on display for viewing and interacting. The best spot for sampling a wide variety of a-life, here you'll find very good online versions of the first such computer program, Life; a colorful adaptation of the biomorphs described in Richard Dawkins's book, *The Blind Watchmaker*; an "ecology toy" featuring sharks; and a swarm of reproducing "boids" that look like squiggly tadpoles or sperm.

Granted, none of these artificial life-forms are as cute and cuddly as their analog progenitors were purported to be, but idly watching these simple creatures swim, reproduce, live, and die is far more fascinating than staring at what look like noodle spices suspended in water. – *Howard Wen* (wen@why.net)

Work That Mouse!



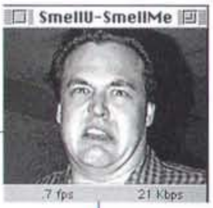
Trudy, a virtual gender illusionist of a certain age, lives in Cyburbia. And tucked in a tiny but glamorous corner of the extensive site devoted to Trudy's true-life adventures, you'll find the *Draginatrix*. The Draginatrix examines the male soul and assigns it a thrilling new drag-queen identity. Genetic females are included in the fun, too: why not adopt a Eurotrashy, Continental Casanova persona?

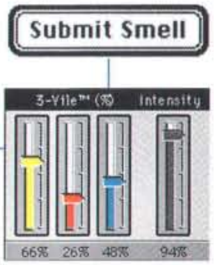
"So many private emails have asked how to start one's life anew, how to taste the world of another gender, how to make café curtains, that I realized something had to be done – and fast," Trudy says. "What, after all, is the root of identity? Your name. To alter an identity, one would start with a name that takes into account your deepest, darkest secrets, and general hygiene. Through some C++ magic and a little bit of perl for that Net touch, there emerged the Draginatrix." And the world weeps with gratitude.

www.datalounge.com/trudy/quiz/index.html

Surf and Smell

www.realaroma.com/





Some three decades after the début of the ill-fated moviegoing experience of "Smell-O-Vision" – a gun barrel-like device at the back of each theater seat released a hissing, perfumey odor (suggesting everything from cigarettes to roses) at key junctures in the film – the technique has now come full circle … to the Internet. At least according to a recent parody page by Agency.com, a New York-based Web marketing firm.

In conjunction with their mythical 3-Vile desktop device, SmellU SmellMe Aroma Conferencing software, and RATML (Real Aroma Text Markup Language), the Agents purport to bring the added dimension of real-time smell to the Web.

According to their Developers' Corner, the three-part hex code within RATML can accurately re-create any and all olfactory experiences (from wet sheep to buttered popcorn) via three primary desktop scents – a variation on the standard RGB color specifiers within HTML. And with the added fine-tuning attributes of Decay, Intensity, and Refresh (similar to client pull), there's supposedly considerable olfactory subtlety possible.

And who knows. Today's parody could always turn out to be tomorrow's killer app. We may soon be asking ourselves: Is it real, or is it *RealAroma*?

Stare Master

users.aol.com/kenkilgore/index.html

Multimedia producer Kenn Kilgore is no stranger to 3-D images and animation spectacles. At *3D Graphics by Kenn*, you can link to a classic 3-D gallery, samples of his interactive animation, QTVR, and a listing of cool related treats (one endorsed by Kai Krause). Install the MovieStar! plug-in and see examples of Kilgore's work that utilize such rendering tools as Infini-D, MacRenderman, and Ray Dream Designer. Warning: the movies can take a while to download.

Interactive Fox-Trot

With *Calvin and Hobbes* and *The Far Side* retired from the comics page, the only strip worth reading is Bill Amend's inventive and insightful *FoxTrot*. Unfortunately, even many large newspapers don't carry the adventures of the funniest family this side of the Simpsons.

Don't despair: the comic – along with *Garfield*, *Bizarro*, *Doonesbury*, the retired *Calvin*, and others – is online at the *UExpress Comics Page*. New strips are posted daily (following a two-week delay) alongside an archive that dates back 14 days. The site also has the usual nonsense: FAQs, bios, a marketplace, even a downloadable *Joust*-like game for the Mac called *Slug-Man* that's based on a comic book drawn by Jason Fox in *FoxTrot*.

Your computer may not hang on the fridge too well, but that's why we have printers.

www.uexpress.com/ups/comics

When the World Wide Web Ain't Enough

Long load times, "404" warnings, slow network connections ... it's no secret that Web use has exploded. But there are many hidden benefits. Heavy traffic on the Web means lighter traffic – and quicker connections – to informative neighborhoods of the Internet that many people ignore: FTP sites, gopher holes, telnet areas, and Usenet newsgroups. What these regions lack in flash, they make up for in substance, offering downloadable goodies, tons of information, real-time multi-user games, and discussions on every subject under the sun. Unfortunately, many search engines do not account for them, and locating directories can be difficult.

Enter *internet-now!* Using an accessible, color-coded menubar, internet-now! sports direct links to "the rest of the Net," making surfing from Usenet to gopher holes as easy as ABC (or even FTP). With an alphabetized index just a click away, you can always find what you're looking for. Do yourself a favor: check out the rest of the Internet – now!

www.internet-now.com/

Random Sound Byte o' the Month
Check out this 1-gigahertz UK chiller;
www.compulink.co.uk/~modified/autowb13.htm
use your mouse to click on the images and cut your own groove.

Thanks to the *Wired* 5.02 Surf Team

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◄ 60 should do HDTV,” he says, “you have to ask why in god’s name they would ever waste digital capacity on it – in which case the whole future of HDTV would be jeopardized.”

There was one little snag in the broadcasters’ scenario: any new channels would have to be supported by extra advertising. “We at Fox have articulated dreams about deploying multiple channels of programming,” Rupert Murdoch said in April 1996. But, he said, “there is no evidence that sufficient advertising revenues exist to support these dreams.”

HDTV *isn’t* good business for broadcasters. They’d be crazy to spend money on display quality when they can exploit captive viewers with low-res video that uses as little bandwidth as possible.

Well, all right! Forget advertising! Why not charge subscription fees for additional, compressed NTSC channels?

There’s something shocking about this concept. After all, broadcast TV has always been free, and broadcasters are expected to honor that inconvenient little obligation to serve the public interest. But Congress has never passed a law to stop TV stations from charging for programs, and Reed Hundt didn’t see any problem in this, either. “If a broadcaster wanted to multicast five channels with one license,” he said in the same New York speech, “would we care if four were subscription channels?… Would there be anything wrong with that?”

Fine! In that case, why not allow broadcasters to go beyond TV altogether? As one of them phrased it with polite, euphemistic understatement, “If we do go digital, we should be able to offer other services.”

Other services? What could that possibly mean? Well, a TV station could fulfill its minimum “social responsibility” by continuing to transmit one free channel in digitized, compressed NTSC, and then it could use the remaining spare bandwidth to sell local paging, or stock quotes, or even software that it could distribute to computers fitted with digital antennas.

Hundt did mildly suggest that if broadcasters wanted to do this kind of thing using the new bandwidth that was loaned to them for a transition to HDTV, maybe they shouldn’t get it as a loan after all. Maybe they ought to pay for it. In fact, if HDTV wasn’t going to happen, maybe the whole upper UHF spectrum should be auctioned, as consumer groups suggested.

As a matter of principle, though, he saw nothing wrong with broadcasters subdividing their original ration of radio-spectrum real estate. If they could find a way to make huge, unprecedented profits by compressing old-style NTSC and selling pay services on the side, they should be free to go right ahead.

Why was he being so obliging? For that matter, why hadn’t Congress worded its instructions to the FCC so that broadcasters would be forced to transmit better pictures, which was obviously the original idea?

The answer lies in the traditional relationship between Congress and broadcasters, broadcasters and the FCC, and the FCC and Congress.

News coverage on networks and local television stations can make or break a political career – and legislators are aware of this. It’s no surprise, then, that some sources at the FCC speak privately and derisively about the “craven attitude” of Congress toward the broadcasting industry. To take just one example of Congress caving in to broadcasters’ demands, consider the federal law that forces every cable company to carry all nationally broadcast network programming as a free service.

On the other hand, broadcasters are highly motivated to get along with the FCC because it has such power over them. This seems to leave the FCC in a position of unchallenged authority, except that its commissioners and chair are hired (and can be fired) by the president of the United States and must do whatever Congress says. This gives them an incentive to maintain good relations with their friends on Capitol Hill.

Finally, FCC officials have a deep-seated desire to avoid annoying their friends in industry, which is natural enough when you realize that many former top-level officials have moved into jobs in the private sector. In the harsh estimation of one university historian who specializes in media studies, today’s FCC commissioners “are a bunch of spineless weasels more under the thumb of industry than at any time in their history.”

Add it all up and you have a tangled mess of codependency in which everyone wants to be nice to everyone else. Small wonder, then, that the FCC has sat on its hands while the kids at the birthday party come up with increasingly far-fetched, greedy strategies to grab more than their share of cake.

Back in 1993, the FCC told a so-called Grand Alliance of industry heavyweights to reach a compromise and agree on a format for HDTV. The alliance then consisted of AT&T, General Instrument, MIT, Philips, Thomson (which now owns RCA), the David Sarnoff Research Center, and Zenith.

On November 28, 1995, after more than two years of bickering and deliberation, the Grand Alliance delivered its verdict: it couldn’t agree on a single standard. Instead, it proposed 18 different standards. Broadcasters would be free to choose from among these options, and TV manufacturers would have to design hardware that would be compatible with all of them. Moreover, one of the formats wasn’t high-definition at all: it was plain old NTSC, digitized and compressed, just the way broadcasters wanted it, so they could free up most of their bandwidth for those excitingly lucrative “other services.”

The Grand Alliance actually claimed this was all in the public interest. Their multiple formats allowed three levels of resolution: 640-by-480, 1,280-by-720, and 1,920-by-1,080 pixels. There would be two aspect ratios: the old 4:3 picture and a new 16:9 wide-screen option. This way, viewers could have a small, cheap, low-resolution, squarish-screened TV in the kitchen and a big, expensive, high-resolution, wide-screened console in the living room. Each unit would be able to convert any of the 18 formats to its own display mode, using a special chipset; and for a suitable price, Grand Alliance members would be happy to license this chipset to other manufacturers - such as the Japanese, for instance.

Clearly, this chipset would inflate the cost of television receivers, so the small, cheap TV in the kitchen wouldn't really be so cheap after all. But the broadcasters were highly influential, and the FCC wasn't going to stand in their way, so multiple formats were the only possible compromise.

The Grand Alliance plan did have one virtue. By bribing all the kids with double helpings of cake, it finally stopped their squabbling. Yet there was one last, unexpected problem: a new bunch of gatecrashers suddenly arrived at the party screaming, "We want some cake, too!"

These newcomers included Apple, Compaq, Intel, Microsoft, Hewlett-Packard, Silicon Graphics, Oracle, and Tandem. They called themselves the Computer Industry Coalition on Advanced Television Service (CICATS), and they hated the Grand Alliance plan because, they said, it ignored the future of television.

Ten years from now, video will be disseminated via the Net like any other form of data. Therefore - obviously! - digital TV should be compatible with the video format that is already being used on computer monitors. You'd think that one of the 18 formats proposed by the Grand Alliance would have satisfied this need, but according to CICATS, it just wasn't so. Their argument was complicated, but one word kept recurring: interlace.

If a picture flashes more slowly than around 50 times per second, the human eye can see it flickering. Movies are shot at only 24 frames per second, but when we view them in a theater, each frame is flashed onto the screen two or three times to minimize the flicker effect.

NTSC television uses its own methods to suppress flicker. In the first one-sixtieth of a second, all the odd-numbered lines of the 525-line picture are transmitted. In the second one-sixtieth of a second, all the even lines are transmitted - and the screen glows persistently enough that the odd lines are still illuminated while the even lines are inserted between them.

This is known as interlacing.

Why not transmit the *whole* picture every one-sixtieth of a second, instead of just half of it? Because when the NTSC format was developed in the 1940s, half a picture was the most that could be sent in one-sixtieth of a second within the available bandwidth.

Unfortunately, interlacing creates some ugly visual defects. Consider a live transmission of a football zipping across the screen. During the first one-sixtieth of a second, the odd-numbered scan lines show the ball on the left. By the next one-sixtieth of a second, the ball has moved, and the even-numbered scan lines show it in the middle of the screen. The odd-numbered lines are still visible, so we see the ball in two places at once. This generally means that fast-moving objects seem smeared or fuzzy in an interlaced display. It also means that if you do a freeze-frame, or if you save a video image as a still picture, objects that were in motion will appear extremely blurred.

Interlaced video also runs into trouble displaying thin horizontal shapes. If the shape is so thin that it coincides with only one of the 525 scan lines, it will appear only in alternating frames, causing it to flash visibly 30 times a second. To suppress this effect, TV cameras automatically thicken any horizontal shape so it will cover at least two scan lines. This of course reduces the amount of detail that the picture can display.

The FCC has done almost as little to revolutionize television as the pope has done to promote birth control. If you think the TV industry is gearing up for HDTV, expect disappointment.

New problems occur when an interlaced picture is digitized and compressed. Compression schemes such as MPEG work by sampling a picture and simplifying it - but an interlaced transmission sends only half the picture at a time. If each half is separately compressed, they may not be a perfect match after they are decompressed by the TV receiver at the receiving end.

Interlaced displays were abandoned by the computer industry years ago, when users started demanding high-quality graphics featuring fine lines and minimal flicker. All computer monitors now generate a complete picture every one-sixtieth of a second. (In Europe, for historical reasons, the standard is every one-fiftieth of a second.) When video is created this way, it's known as *noninterlaced* or *progressive scan*, meaning that each whole frame is drawn on the screen progressively from top to bottom without skipping any lines.

During 1996, according to the Consumer Electronics Manufacturers Association, about 9.4 million progressive-scan computer monitors were retailed to consumers in the United States (not counting sales to businesses). By comparison, about 22.4 million interlaced color TV sets were shipped to dealers (not including projection TVs). Noninterlaced monitors still lag television sets in market penetration, but they're clearly gaining ground, and it seems foolish to ignore their importance as a display medium. With this in mind, CICATS said it was time to junk interlacing. Why not get rid of this cheesy cost-cutting practice once and for all, in the interests of true compatibility?

"We got involved in the debate over digital TV because we didn't think the standard met the needs of the computer industry or the consumer," says Joseph Tasker, vice president for federal government affairs at Compaq, a CICATS member. "We can do a lot better without imposing the cost of building a receiver that is capable of converting so many formats." (Meaning, the multiple formats proposed by the Grand Alliance.)

The Grand Alliance violently disagreed with such arguments. Some of its members claimed that consumers would *never* watch TV on computer monitors, simply because the screens are too small. A formal statement from Zenith accused CICATS of making "unsubstantiated and dubious technical claims" and con-

188 ▶

◀ 187

demned the CICATS proposal as "a last-minute attempt to derail this nine-year process for its own self interests."

Well, certainly the computer industry had its own interests in mind. It believed that people *would* want to watch TV on computer monitors, and it hoped to benefit. It also liked the idea of transmitting computer graphics via TV. This simple desire to meet consumer demand surely seemed reasonable, especially compared with broadcasters' yearning to exploit their free spectrum with "other services."

Imagine a landlord subdividing a house into six apartments, charging six times more rent, *and* getting an exemption from real estate taxes. That's what's happening with public airwaves.

But if CICATS had its way on the interlace issue, there would be less room for those services. A progressively scanned picture will always contain twice as much data as the same picture transmitted in interlaced mode. Therefore, it will always require twice as much bandwidth. This is true even if both pictures are compressed. Clearly, if a TV station owner wants to free up as much "spare" bandwidth as possible, he won't transmit a high-quality, high-capacity progressive scan. He'll stick with the low-quality interlaced mode while claiming that no one can tell the difference.

CICATS saw that if interlacing was permitted, broadcasters would always be tempted to use it. Therefore, the coalition was in no mood to compromise. "The path to progressive scan means not letting interlaced into the broadcast system in the first place," says Compaq's Joseph Tasker. "Once you let it in, it will be extremely difficult to get it out."

In fact, CICATS wanted to get rid of *all* the Grand Alliance formats, and it proposed its own flavor of HDTV instead. The old 4:3 aspect ratio would be eliminated, and the previously proposed 16:9 ratio would be expanded to 2:1 to make it suitable for CinemaScope movies. Images would be encoded using a system similar to Kodak photo-CDs. A low-resolution "base layer" image of 1,024-by-512 pixels would be broadcast for cheap, low-quality receivers along with extra information to tell higher-quality TVs how to enhance the "base layer" to create a superhigh-res 2,048-by-1,024 HDTV picture. This system would enable easy upgrades, because the base layer of data would always stay the same while the fine-detail data could be enhanced to the limits of future technology. Best of all, by eliminating the 18 Grand Alliance formats, CICATS would also eliminate the expensive format-conversion chipset. Cheap low-res TVs really could be cheap after all.

Broadcasters were appalled. The "base layer" of a CICATS picture was one indivisible package that would occupy an entire 6-MHz channel. Every other format would be eliminated – including dear old NTSC! There'd be no room at all for "other services." TV station owners would be forced to do just one thing, and it was the one thing they didn't want to do. They would have to transmit HDTV.

Did the FCC take a side in this final standards battle? Not at all; the new kids were just as welcome at the birthday party as the kids who had been there originally, and if they wanted to promote their own plans for grabbing more cake, they should go right ahead. Chairman Hundt, who has a well-known weakness for jaunts outside Washington, made personal visits to Bill Gates and Steven Spielberg just so he could hear them tell him why CICATS was such a cool concept. Meanwhile, in public statements, he remained noncommittal on the formats issue.

Wasn't there something a little odd about this? If the FCC wasn't willing to mediate – if it wouldn't endorse one format over another or do anything to expedite the decision making process – then what was it good for?

One word: content.

Reed Hundt gives wonderful speeches. They're witty and charming, and they send corporations a message that they love to hear: that government shouldn't stand in the way of the free market. And yet, there are some areas where Hundt appears to assume that regulation is essential. On a talk-radio show, when a listener asked him how she could complain about TV programs that she found offensive, he told her there was going to be a toll-free hotline. Just dial 1-800-CALL-FCC.

Hundt may not have been totally serious (the 800 number has never been implemented), but the FCC has been deeply serious about prohibiting indecent speech on radio and TV.

WFMU is a small, progressive college radio station in East Orange, New Jersey. It almost had its license yanked when one of its disc jockeys played some off-color records. Howard Stern is a notorious talk-radio personality. His employers, Infinity Broadcasting, paid a levy of $1.7 million when Stern persisted in using indecent speech on his show.

All radio stations are painfully aware that they face severe penalties if they violate FCC guidelines. And the FCC goes even further, "discouraging" material that it happens to disapprove of (such as liquor ads on TV) even when this content violates no state or federal laws and is protected by the First Amendment.

This heavy-handed behavior may seem to violate the no-hassles relationship between the government, the FCC, and the broadcasting industry, but on closer inspection it poses no problems. Broadcasters, after all, don't have to use four-letter words on the air in order to make money. In fact, since the indecency ban affects them equally, it doesn't diminish anyone's market share. Thus, the FCC can look as if it's doing something useful without hurting broadcasters in the area they care most about: profit. The FCC is more cautious about telling stations what they must broadcast. Still, it had to placate consumer groups about the loan of new channels, so Reed Hundt suggested, in an apologetic tone, that each broadcaster should have to devote a minimum number of hours a week to educational children's programs, plus free prime time for political candidates during the election season.

Where else have we seen this paradoxical mix of conservative free-market rhetoric and social engineering? The name Bill Clinton may come to mind, and – surprise! – there just happens to be a framed letter from Clinton on the wall of the waiting room outside Hundt's office, emphasizing that educational programming should be a high priority for all broadcasters.

Hundt was appointed by Clinton. (He attended St. Alban's School in Washington, DC, with Al Gore, and he met Bill and Hillary at Yale Law School.) Does Hundt really believe his own speeches, or is he a high-class ventriloquist act, with Clinton doing the talking? To find out, I visited him at the FCC.

He's a handsome, charming man, with a youthful grin and a full head of thick black hair. He gave me a firm handshake and a warm smile as he welcomed me to a huge office where a conference table stands beneath an American flag that covers an entire wall. But as he started talking, I realized that the no-bullshit rhetoric of his speeches is misleading. I found myself dealing with a seasoned political animal no different from any legislator parrying questions on *Meet the Press* or *Face the Nation*. Ultimately, he projected as much sincerity as a photocopy machine salesman. He also minimized my opportunity to ask questions with the time-honored tactic of giving very long answers.

I began by asking how much airtime he would demand for public services. Hundt spent a good five minutes reflecting lyrically on the vital importance of broadcasting as a national resource. Finally, he said, "Broadcasting licenses are granted in return for delivering free TV for the public good. Digital TV licenses should perpetuate that idea; it is a wise idea to guarantee that certain dimensions of the public good be served. Children's programming, and free time for political broadcasting – perhaps 5 percent of airtime – could be devoted to those purposes."

And where did he stand on the interlace question? This provoked an even longer stream of eloquent waffle. The closest I could get to a definitive statement was when he told me that "for broadcasters to take the interlaced idea and add it to high definition is to make a unique product, but maybe in the same way as the pressure cooker – everybody said it was going to sell like hot cakes, but it didn't." Did this mean he was actually leaning toward the CICATS standard? He was reluctant to be more specific. But he seemed enamored of the computer industry, and he referred to Bill Gates as a "genius."

Turning to HDTV, would he really not require broadcasters to transmit high-definition pictures? Would he allow them, instead, to transmit the same old NTSC programs in compressed, digitized form, letting them sell "other services" on the side, demanding nothing in return, even though the spectrum could be worth billions of dollars?

Hunt responded by asking a question: "How much broadcast TV is enough?" He talked around this point for a long while, then finished with a fairly clear statement: "Let's tell the broadcasters to give us as much free digital TV as they give us analog TV today. An equal number of channels. Beyond that, let's allow them to use the digital bits for whatever they want, including sending software application packages over the air to PCs with digital antennas, some subscription services so that digital broadcasters can have a revenue stream, and multichannel packages that compete with cable and satellite digital."

But wait. If broadcasters are free to cram all these moneymaking schemes into a traditional 6-MHz channel, there will be no room left for an HDTV signal. Won't this mean the death of HDTV?

Hundt shrugged and gave me his synthetically charming smile. "I'm hard-pressed to say who in America is waiting to buy a $3,000 home theater all geared up to watch nothing. Cable doesn't want to deliver to it, satellites don't want to deliver to it. Why this is a good business plan for broadcasters is a mystery."

If broadcasters want to carve up their original ratio of spectrum real estate, it's fine by Reed Hundt. "Let's allow them to use the digital bits for sending whatever they want," he says.

Well, HDTV *isn't* a good business plan for broadcasters so long as they retain their government-sponsored monopoly. They'd be crazy to spend money on fantastic display quality when they can simply exploit a captive audience with low-quality video that uses as little bandwidth as possible.

I left Hundt's office with the clear impression that he had no interest whatsoever in mandating a better TV picture. This was confirmed in November 1996 when Hundt talked to journalists and stated flatly that the FCC would not promote HDTV in any way.

Of course, Hundt does not control the FCC; there are four commissioners, each with a vote equal to his, and not all of them share his enthusiasm for procrastination. Earlier in November, commissioner Susan Ness demanded that broadcasters, manufacturers, and the computer industry reach a final, definitive agreement before the end of the month. Suddenly it seemed as if a definitive standard might be set after all.

But when the result was announced on November 25, it was a bad joke. There was still no way to get everyone to agree even on a range of standards, and the FCC still wasn't willing to intervene – so it simply gave up and freed the broadcasters and the computer industry to go their separate ways. They could use the Grand Alliance formats, or they could even invent new ones.

One basic requirement was imposed, defining low-level data packets in the bitstream. But broadcasters would be free to use these packets to send anything at all, including text or computer data. In the words of the agreement, it "provides for extensibility of services."

The implications should be obvious. If broadcasters feel a strange philanthropic need to devote their entire bandwidth to HDTV, well, they can still do that. On the other hand, if they feel at all tempted by an unprecedented opportunity to reap huge amounts of money by marketing "other services" in conjunction with digitized NTSC – well, they can do 190 ▶

◄189 that, too.

Which will they choose? At this point it looks like RIP, HDTV.

In the end, only one question really matters: What are we missing?

Maybe HDTV isn't really such a big deal. After all, do we need twice the resolution and a wide-screen aspect ratio to watch reruns of *Married ... With Children* or *The Simpsons?*

Of course not, but so long as we're stuck with quaint old NTSC color, it's hard for television to offer us better programming. "You shoot pictures for the display," says Andrew Lippman at the Media Lab. "This means that with the exception of news and sports, you shoot close-ups for television." Even serious movies are created differently when they're made for TV. Directors avoid long shots and subtle compositions because video can't resolve fine detail. There's a general principle here: if you have a poor-quality output device (in this case, a television set), no one's going to waste time creating high-quality input. On the other hand, if the output device improves, there's a new incentive to create better material for it.

Perhaps it's hard to believe that a better TV picture could encourage better programming. But consider the case of FM radio. So long as AM ruled, almost everyone tolerated the sound quality of 1950s doo-wop music. High fidelity was a luxury reserved for an élite minority of eccentric fanatics who owned massive stereo systems that cost almost as much as a new automobile. Then FM opened a new conduit between popular artists and consumers. Suddenly, everyone could hear music with a full dynamic range, and musicians took advantage of this. Studios that had done everything on a single track in a single take started installing 32-track mixing consoles with Dolby noise reduction. Today we take CD-quality sound for granted, but the transition to it would have dragged on much longer if FM hadn't helped to educate public taste, creating a demand for high fidelity that record companies were forced to satisfy.

In television this kind of upgrade never occurred, and some broadcasters claim it has never been necessary. Stanley Hubbard is chair, president, and CEO of Hubbard Broadcasting, which operates a Minneapolis TV station that was founded by his father. In 1981, Hubbard embarked on a grand ambition: he received the first license for a direct-broadcast satellite (DBS), which he saw as "a chance to go around the [network] gatekeepers, directly to the people." He raised $140 million, launched his satellite, entered into a partnership with DirecTV, and started his service in 1994. Two years later, it had reached nearly 2 million dish owners. Hubbard is a visionary; he succeeded with DBS because he saw its potential far ahead of his competitors. Yet when I spoke to him in mid-1996, his vision became strangely myopic as he contemplated HDTV. "I've come to the conclusion consumers aren't going to spend their money on it," he told me. "People watch programs, not pictures. Once the picture quality reaches a point that's satisfactory, they don't care."

FCC officials have a deep-seated desire to avoid annoying their friends in the industry, natural enough when you consider how many of them land jobs at companies they once regulated.

You hear the same story from people in the cable industry. Bob Van Orden is business director of digital video systems at Scientific Atlanta, which makes set-top decoder boxes. "People care about the show, not the shape of the screen," he says. "For years everyone put up with black-and-white TV, then poor-quality color, just because the programming was interesting."

On the other hand, according to television manufacturers, when viewers are allowed to see something better, they do want it. Bruce Allan of Thomson Consumer Electronics describes focus groups where people compared highest-quality digitized NTSC with true HDTV. "Consumers very definitely can see the difference," says Allan, "and a portion of them indicated they would pay a premium for it. I can't tell you the exact number, because it's proprietary information. But it was a significant number, a high percentage - sufficient to encourage us to make HDTV sets." In fact, Thomson believes consumers would be willing to pay $1,000 to $1,500 extra for an HDTV receiver.

Who's correct? All the players have powerful vested interests, and as I gathered their statements, I realized that none of them could be trusted. Therefore, I had to see for myself.

Hubbard told me forcefully that the NTSC picture that he transmits via satellite is so clean, so much better than NTSC transmitted via cable, there's no need for HDTV.

To verify this I had to go only as far as Circuit City. There I found a set displaying a picture of a live baseball game that the salesman assured me was coming in via DBS. The quality was extremely disappointing. There were blatant artifacts: black lines, for instance, around any bright object with a neutral background. Could the antenna be out of adjustment? Unlikely; a digital transmission doesn't allow any fine-tuning, just as a CD player doesn't allow you to adjust the tracking. The bit stream either comes through intact, or you lose the picture entirely.

My next stop was Cambridge, Massachusetts, where Polaroid Corporation has built the world's first and only progressive-scan HDTV camera. Polaroid is not thriving; its operating profit has declined in an almost straight line from more than 14 percent of sales in 1989 to 4 percent in 1995. There have been some excellent new Polaroid products in the graphic arts field, including a fine digital still camera and a fast, affordable color-slide scanner. But the company clearly needs a boost from a new product, so I braced myself for an onslaught of HDTV hype.

It never happened. There's a laid-back, folksy charm to the offices, which have a '60s look. I felt as if I were visiting a family business as I chatted with Stuart Spitzer, the mild-mannered, gray-haired leader of the Image Sensor Technology Division. Spitzer maintained a deeply serious style, leavened by a Snoopy logo embroidered on the pocket of his denim shirt.

He emphasized the advantages of progressive scan – "you could be sitting at home, capture a freeze-frame, and put it through Photoshop without any format conversion to degrade the quality" – and he pointed out that while the Polaroid camera conforms with one of the Grand Alliance formats, it also has the same pixel rate as Japanese HDTV, so a Sony high-definition tape deck can store the data.

Then he took me to a room down the hall. I walked in and saw two monitors, one an expensive special-purpose unit with a 16:9 aspect ratio, the other an HP A4033, a 20-inch multisync computer monitor with a street price of around $2,000. The pictures were virtually identical, and they were simply beautiful.

James Toker, a big, shy man who helped develop Polaroid's image sensors, focused the camera on various still-life objects – from stuffed toys to a table setting – chosen for their high detail, saturated color, and wide variations in brightness.

In every case, the camera generated a picture that looked like a museum-quality photograph, with soft, subtle, lifelike color tones, razor-sharp detail, no distortion, no scan lines, no flicker, no blurring, no blemishes of any kind. HDTV is so far beyond television as we know it, it doesn't look like television. The Polaroid camera has a resolution of just 1,280-by-720, but still it's a picture suitable for framing.

I'd certainly pay money to watch my favorite movies in this quality, in the correct wide-screen format, in definition fine enough to show the grain of the original film stock. It angers me to think that I might have this option right now, on my existing computer monitor, if the FCC had taken action a couple of years ago and set a standard that would have given hardware manufacturers the necessary assurance to start building new-generation cameras and VCRs.

Instead, like everyone else in America, I'm still watching movies that are chopped to fit the wrong aspect ratio in a crappy color format that hasn't been upgraded for more than 40 years. A sizable portion of the picture is lost in overscan (usually we see only about 480 of the 525 lines), there's lousy detail, and the picture is riddled with annoying artifacts.

I'm stuck with this ancient system because Congress and the FCC have maintained absolute power over the airwaves while refusing to exercise that power in any way that broadcasters might dislike.

George Keyworth of the Progress and Freedom Foundation has suggested that the FCC should be totally dismantled and all the broadcast spectrum should be sold to private bidders. This sounds drastic, but deregulation certainly would crack open the broadcasting cartel. A massive auction of commercial spectrum would turn television into a truly competitive, consumer-driven industry like telecommunications. So long as broadcasting is protected from the free market by legislators who depend on TV to get themselves reelected, Congress will continue giving broadcasters special treatment and favors, and consumers will suffer.

It's not too late. Congress has been known to bend to public opinion. It reserves the right to stage a new debate on digital television and alter its previous policy at any time.

Note that Keyworth's plan is a genuine free-market solution, very different from the rhetoric in Hundt's speeches. True, the FCC has freed broadcasters to use any format they like; but because television is open only to a limited number of players, there cannot be the kind of competition that we've seen in the computer industry, where even a giant like Microsoft can feel threatened by a newcomer like Netscape.

Under its government-sponsored system, the broadcast industry has become so comfortable and complacent, as Andrew Lippman puts it, "its idea of a major innovation is the miniseries." Clearly, it's overdue for a shake-up. Yet genuine deregulation would disrupt the cozy codependence that has existed for decades between broadcasters and Congress, and Congress and the FCC, and the FCC and broadcasters. For this reason, it's unlikely to happen, and there's only one real hope for big changes in television: the Net.

Sooner or later the Internet will permit high-resolution video, and online bandwidth should become inexpensive enough to allow cheap transmission of high-definition pictures. This will open up a truly free market instead of a government-sponsored cartel.

On the other hand, the broadcasting industry has gradually become aware of this ominous prospect. Its trade book, *Broadcasting & Cable*, put it this way in a recent editorial: "The Internet is in the process of creating a giant international digital TV medium from which broadcasters dare not be excluded."

And if they don't want to be excluded, they'll feel a natural need to start lobbying for government regulations to favor them.

In the meantime, we'll continue receiving television from the same sources that supply us today: cable, satellite, and local stations. Will none of these media offer better picture quality?

The situation is not totally hopeless. NBC claims it will start transmitting HDTV to enhance its product in competition with cable and DBS. But NBC can't force its affiliates to upgrade their equipment, and they have an obvious motive to stick with NTSC. Likewise, cable companies and DBS are less than thrilled by the idea of high-definition pictures that will take two or three times as much capacity as regular pictures while generating no extra revenue.

We'll certainly see digitized NTSC, because this is the option that frees up the maximum amount of "spare" spectrum for broadcasters. By mid-1998 we'll see TV sets that can display digitized versions of the same old picture, but true wide-screen HDTV will almost certainly remain a high-cost option for technophiles, like high-fidelity sound back in the 1950s, before the era of FM radio. If hardly anyone can receive a high-definition picture, why should people buy expensive wide-screen sets to receive it? And if there are hardly any wide-screen sets out there, why should manufacturers start marketing high-definition VCRs?

If that sounds discouraging, 192 ►

◄ 191 consider this: The regulatory process still isn't over. The FCC hasn't issued a ruling, yet, on the explosive question of spectrum allocation. No one knows whether extra channels will be loaned to broadcasters so they can transmit digitally while they also maintain their old analog signals, or whether the extra spectrum will be auctioned instead. A final determination is likely some time in March 1997 – but even that won't be the end of the story. There'll be an additional period for formal objections, followed by an opportunity for lawsuits. And since there are 1,500 commercial TV stations, 4 networks, 363 public TV stations, and at least 160 cable channels in America, we can expect the FCC to spend some time in court if it attempts to charge anything at all for the "loaner" channels.

Also, thanks to Bob Dole (who held up the entire 1996 Telecommunications Reform Act in protest against the "spectrum giveaway"), Congress reserves the right to stage a new debate on digital TV and alter its previous policy at any time. If it does change the rules (which may conceivably happen before you read this), there'll be an opportunity for still *another* round of objections and negotiations.

It would be nice to find something positive in this sorry mess. Perhaps we can see the endless round of delays as a regrettable but necessary part of the open democratic process. Perhaps we can argue that the FCC's laissez-faire policy is more benign than heavy-handed, dictatorial lawmaking. We could even consider that letting kids brawl with each other till they collapse from exhaustion is one way to guarantee that they will eventually reach a compromise.

But it's a slow way to slice cake. ■ ■ ■

Additional Information:

Library of American Broadcasting: ***www.itd.umd.edu/UMS/UMCP/BPL/bplintro.html***

FCC: ***www.fcc.gov/***

BRP Publications (publisher of Telecommunications Reports): ***www.brp.com/***

Handy Reference Guide to the Jargon of the Airwaves

ACATS: Advisory Committee on Advanced Television Service, formed in 1987 by the FCC to develop an American HDTV format.

analog TV transmission: a signal that varies continuously, representing fluctuations in color and brightness.

aspect ratio: the width of a picture relative to its height. If an NTSC picture is 4 feet wide, it will be 3 feet high; thus it has a 4:3 aspect ratio.

bandwidth: a range of frequencies used to transmit information.

broadcaster: a company that owns a transmitter serving a community. Not to be confused with a network.

channel: a 6-MHz section of the broadcasting spectrum allocated for one analog NTSC transmission.

CICATS: the Computer Industry Committee on Advanced Television Standards, currently consisting of Apple Computer, Compaq, Dell, Intel, and Microsoft.

DBS: Direct Broadcasting via Satellite – the recent innovation allowing consumers to receive programs via a pizza-sized dish that is locked onto one satellite source. The signal is NTSC, digitized and compressed via a proprietary format, and decompressed by a set-top box.

FCC: the Federal Communications Commission, which advises Congress on technical issues and regulates all forms of telecommunications.

frequency: the number of times per second that a signal fluctuates. The international unit for frequency is the hertz, abbreviated Hz. One thousand hertz equals 1 KHz (kilohertz). One million hertz equals 1 MHz (megahertz). One billion hertz equals 1 GHz (gigahertz). Television is broadcast in frequencies ranging from 54 MHz to 216 MHz (VHF) and 470 MHz to 806 MHz (UHF).

Grand Alliance: AT&T, General Instrument, MIT, Philips, Thomson (which now owns RCA), the David Sarnoff Research Center, and Zenith.

HDTV: any of the wide-screen, high-definition TV formats invented in Japan, Europe, and the United States, offering better resolution than pre-1970 TV formats.

interlace: a system for saving bandwidth and cutting costs by transmitting odd-numbered scan lines in one sweep, then even-numbered scan lines in the next sweep so only half of the picture needs to be sent each time.

MHz: see frequency.

MPEG: Moving Picture Experts Group, which developed a system for compressing digitized video to save bandwidth.

network: a company that creates TV programs and distributes them nationally via affiliated broadcasters.

NTSC: the National Television Systems Committee, established by the FCC to create a standard for American TV transmission. The NTSC format consists of 525 lines, interlaced, with a frame rate of 60 lines per second.

pixel: a single displayable video dot.

programmer: a company such as HBO that creates TV programs for distribution.

progressive scan: a noninterlaced picture in which all the scan lines are transmitted in an unbroken sequence, creating an entire single frame of a TV picture.

spectrum: a range of frequencies available for over-the-air transmission.

UHF: ultra high frequency, the range used by TV channels 14 through 69.

VHF: very high frequency, the range used by TV channels 2 through 13.

Doomslayer

◄ 140 Mr. Popularity. He got fired from jobs in the navy because he hated the customary ass-kissing, sucking-up, and yessir requirements. Nor has he ever been much for schmoozing, glad-handing, or the latter-day manners of get-along, go-along.

"Socially I was always a bit marginal," he admits. "Also, there always lurked inside me some irreverence for authority and orthodoxy."

None of this held him back academically. He got a bachelor's in experimental psychology from Harvard, an MBA from the University of Chicago, and, two years later, in 1961, a PhD in business economics from the same school.

He was not one of those MBAs whose closest contact with the gritty business world was going down to the corner newsstand to purchase a copy of *The Wall Street Journal*. The year he got his doctorate he started and operated his own business, a mail-order firm that sold quality teas, coffees, and a book on how to make beer at home. The enterprise was successful enough, but not so much as the book he later wrote about it, *How to Start and Operate a Mail-Order Business* (McGraw-Hill, 1965), still in print and currently in its fifth edition.

He got married and had three kids and wound up, successively, as professor of advertising, of marketing, and of business administration and economics at the University of Illinois at Urbana-Champaign. Then in 1966 or so, he had his big idea about how to solve the airline overbooking problem. Anticipating no-shows, airlines routinely oversold their flights. But when more people showed up at the gate than the plane had seats, pandemonium ensued. *Well, why not pay people to get off the plane?* he wondered. *Offer them enough to make it attractive. It would be a voluntary system, and everyone would win.*

So in his practical, down-to-earth, this-is-only-reasonable fashion, he submitted his suggestion to the airlines. The idea was laughed at, mocked, and ridiculed as unrealistic and unworkable. An official at Pan American replied: "Of course, we instituted the procedure immediately, after having the instructions translated into 18 languages." Ha ha ha, thank you, and goodbye.

Eleven years later, in 1977, Simon hadn't given up on the scheme. He published it in *The Wall Street Journal*, in an op-ed piece titled "Wherein the Author Offers a Modest Proposal." And lo and behold, a year after that, when economist Alfred Kahn headed up the Civil Aeronautics Board, Simon's proposal was put into practice. It was a raging success from the start, remains so to this day, and anyone who's ever voluntarily offloaded themselves from a plane for cash or free miles owes a nod of thanks to Julian Simon.

Still, that was a mere flash in the pan, and Simon's overall impact on the world at large was rather less massive than he desired. He was not making a name for himself, not setting the world on fire.

But there were those who were - Paul Ehrlich, for example.

Simon recalls watching in horror as Ehrlich held Johnny Carson in a mystic thrall. "It absolutely drove me out of my skull."

Ehrlich, a Stanford University entomologist who as a youth had seen his best butterfly hunting grounds churned under the real estate developer's plow, wrote the runaway best-seller *The Population Bomb*. Published in 1968, the book was solidly Malthusian.

"The battle to feed all of humanity is over," it began. "In the 1970s and 1980s hundreds of millions of people will starve to death in spite of any crash programs embarked upon now. At this late date nothing can prevent a substantial increase in the world death rate, although many lives could be saved through dramatic programs to 'stretch' the carrying capacity of the earth by increasing food production and providing for more equitable distribution of whatever food is available. But these programs will only provide a stay of execution unless they are accompanied by determined and successful efforts at population control." And so on, The Complete and Authoritative Litany, for the next 200 pages.

This late-breaking Malthusian outburst, strangely enough, did set the world on fire. The book sold 3 million copies, became the best-selling environmental tract of all time, and got the author on *The Tonight Show*.

At home in Illinois, Simon watched Ehrlich on the Johnny Carson show, and he went bananas. In fact, more bananas than he'd ever before gone in his life. Simon had by that time decided that the Malthusian stuff was the purest mythology, an invention out of whole cloth, a theory that was entirely controverted by every available empirical fact. And here was Paul Ehrlich on TV spreading his stardust all over the place and holding Johnny Carson in some kind of mystic thrall.

"It absolutely drove me out of my skull," he recalls. "Here was a guy reaching a vast audience, leading this juggernaut of environmentalist hysteria, and I felt utterly helpless. What could I do? Go talk to five people?"

As bad an experience as that was, matters immediately got worse. The next year, 1969, Ehrlich published an article called "Eco-Catastrophe!" in *Ramparts*. "Most of the people who are going to die in the greatest cataclysm in the history of man have already been born," it said. "By that time [1975] some experts feel that food shortages will have escalated the present level of world hunger and starvation into famines of unbelievable proportions."

Then, in 1974, Ehrlich and his wife, Anne Ehrlich, also a Stanford biologist, published a new book, *The End of Affluence*, in which they warned of a "nutritional disaster that seems likely to overtake humanity in the 1970s (or, at the latest, the 1980s). Due to a combination of ignorance, greed, and callousness, a situation has been created that could lead to a billion or more people starving 194►

Doomslayer

◄ 193 to death.... Before 1985 mankind will enter a genuine age of scarcity" in which "the accessible supplies of many key minerals will be nearing depletion."

Julian Simon read this stuff, which he viewed as unalloyed and total nonsense. He brooded and fumed and stewed in his juices. He experienced what might be called a personal lull.

And then, finally, in 1980 he emerged from the cocoon. He'd gone into it as a humble professor of marketing and a passive spectator of global death sentence forecasts. But now, suddenly, he broke out into the light of day, he sprang forth onto the world stage, he started swinging his diamond-tipped sword - *thwick-thwack!* - as ... The Doomslayer!

His response in *Science* slashed every reigning doomsday dragon neatly in half, leaving them flapping on the ground like fish.

The rebirth occurred in the pages of *Science*, in an article titled "Resources, Population, Environment: An Oversupply of False Bad News." It led with a summary that became a manifesto:

False bad news about population growth, natural resources, and the environment is published widely in the face of contrary evidence. For example, the world supply of arable land has actually been increasing, the scarcity of natural resources including food and energy has been decreasing, and basic measures of U.S. environmental quality show positive trends. The aggregate data show no long-run negative effect of population growth upon standard of living. Models that embody forces omitted in the past, especially the influence of population size upon productivity increase, suggest a long-run positive effect of additional people.

Written in the form of Statement followed by Fact, every reigning doomsday dragon was neatly slashed in half, the severed beasts left flapping around on the ground like fish.

Statement: The food situation in less-developed countries is worsening.

Fact: Per capita food production has been increasing at roughly 1 percent yearly - 25 percent during the last quarter century.

Statement: Urban sprawl is paving over the United States, including much "prime agricultural land" and recreational areas.

Fact: All the land used for urban areas plus roadways totals less than 3 percent of the United States.... Each year 1.25 million acres are converted to efficient cropland by draining swamps and irrigating deserts.... A million acres yearly goes into additional wilderness recreation areas and wildlife refuges, and another 300,000 acres goes for reservoirs and flood control.

So on and so forth, fact piled upon fact, paragraph after paragraph, all of it buttressed by tables, charts, graphs, and diagrams, plus 42 footnotes, many of them containing additional data.

Letters to the editor poured into *Science* in an unseemly rush. A few of them expressed partial agreement, but the majority were heavily critical. Many of them repeated statutory items of The Litany - "human beings, like any other species, have the biological capacity to overrun the carrying capacity of their habitat" - and there were even some feeble attempts at humor: in extrapolating from past trends, said one writer, Simon is like "the person who leaped from a very tall building and on being asked how things were going as he passed the 20th floor replied, 'Fine, so far.'" (Simon's response: "I think the better story is about somebody who has a rope lifeline and falls off the 15th floor. Somewhere about 30 feet above the ground, she lets go of the rope. You ask her, 'Why did you let go of the rope?' And she answers, 'It was going to break anyway.' That's how many activists would like us to behave.")

Anne and Paul Ehrlich, along with two energy and natural resource experts, John Holdren and John Harte, wrote their own letter to the editor. After charging Simon with various "errors about the economics of scarcity," they went on to make some new doomsday predictions: "If deforestation for agriculture proceeds on a large enough scale, the resulting pulse of carbon dioxide may combine with that from increasing fossil-fuel combustion to alter global climate in a way that undermines food production to an unprecedented degree." They also corrected one of Simon's data points having to do with electricity, which Simon claimed had gotten cheaper. "The fact is," they said, "that real electricity prices bottomed in 1971 and were already up 18 percent from that low point in 1972." An 18 percent increase where Simon said there'd been a decline!

"I was taken aback," said Simon in his published reply. "Holdren and Harte are energy scholars. I checked Fig. 1 and other sources but could see no sign of their 18 percent." So he placed a phone call to the coauthor of the report cited by Holdren, Harte, and the Ehrlichs. "He, too, was puzzled. Upon investigation, the 1971 number (80.2) proved to be a typographical error and should have been 93.3. So much for Holdren et alia's 'fact.'"

The battle lines now drawn, it was not long before Ehrlich and Simon met for a duel in the sun. The face-off occurred in the pages of *Social Science Quarterly*, where Simon challenged Ehrlich to put his money where his mouth was. In response to Ehrlich's published claim that "If I were a gambler, I would take even money that England will not exist in the year 2000" - a proposition Simon regarded as too silly to bother with - Simon countered with "a public offer to stake US$10,000 ... on my belief that the cost of non-government-controlled raw materials (including grain and oil) will not rise in the long run."

You could name your own terms: select any raw material you wanted - copper, tin, whatever - and select any date in the future, "any date more than a year away," and Simon would bet that the commodity's price on that date would be lower than what it was at the time of the wager.

"How about it, doomsayers and catastrophists? First come, first served."

In California, Paul Ehrlich stepped right up – and why not? He'd been repeating the Malthusian argument for years; he was sure that things were running out, that resources were getting scarcer – "nearing depletion," as he'd said – and therefore would have to become more expensive. A public wager would be the chance to demonstrate the shrewdness of his forecasts, draw attention to the catastrophic state of the world situation, and, not least, force this Julian Simon character to eat his words. So he jumped at the chance: "I and my colleagues, John P. Holdren (University of California, Berkeley) and John Harte (Lawrence Berkeley Laboratory), jointly accept Simon's astonishing offer before other greedy people jump in."

Ehrlich and his colleagues picked five metals that they thought would undergo big price rises: chromium, copper, nickel, tin, and tungsten. Then, on paper, they bought $200 worth of each, for a total bet of $1,000, using the prices on September 29, 1980, as an index. They designated September 29, 1990, 10 years hence, as the payoff date. If the inflation-adjusted prices of the various metals rose in the interim, Simon would pay Ehrlich the combined difference; if the prices fell, Ehrlich et alia would pay Simon.

Then they sat back and waited.

Between 1980 and 1990, the world's population grew by more than 800 million, the largest increase in one decade in all of history. But by September 1990, without a single exception, the price of each of Ehrlich's selected metals had fallen, and in some cases had dropped through the floor. Chrome, which had sold for $3.90 a pound in 1980, was down to $3.70 in 1990. Tin, which was $8.72 a pound in 1980, was down to $3.88 a decade later.

Which is how it came to pass that in October 1990, Paul Ehrlich mailed Julian Simon a check for $576.07.

A more perfect resolution of the Ehrlich-Simon debate could not be imagined. All of the former's grim predictions had been decisively overturned by events. Ehrlich was wrong about higher natural resource prices, about "famines of unbelievable proportions" occurring by 1975, about "hundreds of millions of people starving to death" in the 1970s and '80s, about the world "entering a genuine age of scarcity."

In 1990, for his having promoted "greater public understanding of environmental problems," Ehrlich received a MacArthur Foundation "genius" award.

By the time he'd won the bet, Simon and his family had moved back to the East Coast, he to take up a position as professor of business administration at the University of Maryland, and his wife, Rita Simon, a sociologist, to become professor of criminal justice at the American University in Washington, DC. They moved into a red brick house in Chevy Chase, Maryland, an upper-middle-class community inside the Beltway.

The house had computers on every floor, two Xerox copiers, and an assortment of exercise machines on which Julian Simon read books or newspapers while trying to keep his spare and straight body in fighting trim. When it wasn't raining, snowing, or more than 100 degrees outside, he did his research and writing out on the deck, sometimes with a wet sponge covering his shaved bald head. He'd sit there in the shade of the mulberry tree, binoculars nearby to stare at birds – particularly hummingbirds that came to a feeder. And with battery-acid coffee from a thermos that looked as if it came over on the *Mayflower*, he'd tilt at new windmills.

For reasons he could never comprehend, people were inclined to believe the very worst, as if they'd been vaccinated against facts.

He always found it somewhat peculiar that neither the *Science* piece nor his public wager with Ehrlich nor anything else that he did, said, or wrote seemed to make much of a dent on the world at large. For some reason he could never comprehend, people were inclined to believe the very worst about anything and everything; they were immune to contrary evidence just as if they'd been medically vaccinated against the force of fact. Furthermore, there seemed to be a bizarre reverse-Cassandra effect operating in the universe: whereas the mythical Cassandra spoke the awful truth and was not believed, these days "experts" spoke awful falsehoods, and they *were* believed. Repeatedly being wrong actually seemed to be an *advantage*, conferring some sort of puzzling magic glow upon the speaker.

There was Lester Brown, for example, founder and president of the Worldwatch Institute, who in 1981 wrote: "The period of global food security is over. As the demand for food continues to press against the supply, inevitably real food prices will rise. The question no longer seems to be whether they will rise but how much."

All during the 1980s, however, wheat and rice prices declined; in mid-century, in fact, they reached all-time lows. But this made no difference, and in 1986, for his work on the "global economy and the natural resources and the systems that support it," Lester Brown, too, received a MacArthur Foundation "genius" award.

Julian Simon never received a MacArthur award.

"MacArthur!" he says. "I can't even get a McDonald's!"

This did not discourage him. Doomslaying was a thankless task, but it had to be done, like taking out the garbage: it had to be carted to the dump today even if there'd be another big pile of it tomorrow.

So Simon penned tract after tract pleading his case: *The Ultimate Resource* (Princeton University Press, 1981), arguing that the most valuable resource of all was people; *Theory of Population and Economic Growth* in 1986; *Population and Development in Poor Countries* in 1992, and so on. In all, he wrote or edited a rough dozen such books, all of them aimed at demolishing one or another tenet of The Litany. But the nearest he got to that MacArthur was a senior fellowship from the conservative Cato Institute.

Naturally, he received a fair

196►

◄ 195

amount of bad press for all this heresy, particularly for his pet claim that what the world needs most is lots of additional human beings. They're not just mouths to feed, he argued. Newborn babes grow up to be creative adults; they turn into individuals who contribute and achieve, who give back far more than they ever take.

But nobody could believe it.

"He's overly optimistic," said Peggy Rizo, then of the Washington, DC-based Population Crisis Committee, now called Population Action International. "He is an economist who is trying to transpose what he believes to be the American prairie experience into the experience of crowded areas like Africa, Central America, and Asia."

"What does it mean in terms of the quality of life of the people of the 21st century when cities are joined to cities and we have just several huge megalopolises?" asked Rupert Cutler, then executive director of the Environmental Fund, which became Population Environment Balance, headquartered in Washington, DC. "I think we can predict a pall of brown air over these cities. We can predict water shortages, joblessness ... and crime."

Well, it wasn't as if Julian Simon hadn't heard *that* before.

Finally, in 1995 he came out with his crowning fact-feast and catalog of bounty, a book he edited called *The State of Humanity*. Almost 700 pages of dense text plus charts and figures, the quantity of factual information in it was nothing short of amazing. Simon had data you didn't even know people track, such as:

- World cereal yields, 1950-1990.
- Declining crowding in American housing, persons per room, 1900-1987.
- Northeast Brazil: apparent per capita daily consumption of major starchy staples among low-income classes, 1974-1975.
- Industrial lead pollution at Camp Century, Greenland, since 800 BC.
- Oxygen content (in milliliters per liter) at 100 meters depth at Station F 12 in the Bothnian Bay of the Baltic Sea 1900-1968.

Arcane as some of it was, Simon was extremely adept at using this material in formal debates. In July 1996, at a public event sponsored by the World Future Society, Simon debated Hazel Henderson, a private researcher and author of *Building a Win-Win World* (see "Win-Win World," page 152). Henderson, who was trying to make a case that government regulation was responsible for reduced air pollution, came armed with a graph showing a decline in pollution levels in London since the late 1950s. The slope of the line was clearly downward, illustrating, she said, the effect of London's Clean Air Act of 1956.

You have to focus on the long-term trends, Simon insists, not just pick and choose little fleeting data chunks that support your case.

In his rebuttal period, Simon presented a graph of his own. Whenever he presents any data, his practice is to present the figures going all the way back to day one, to the start of record-keeping on the parameter in question. You have to focus on aggregate trends over the long term, he insists, not just pick and choose some little fleeting data chunks that seem to support your case. So his own chart of smoke levels in London stretched back into the 1800s, and the line from the 1920s on showed a constant and uniform downward slope. "If you look at *all* the data," he said, "you can't tell that there was a clean-air act at any point."

Anyone who wonders about the accuracy of Simon's data or conjures up rafts of competing data on the other side of the issue will be met with Simon's claim that: "There are no other data." His statistics, he claims, come from the "official" sources, the standard reference works that everyone uses.

"Test for yourself the assertion that the physical conditions of humanity have gotten better. Pick up the US Census Bureau's *Statistical Abstract of the United States* and *Historical Statistics of the United States* at the nearest library. They're accessible to any schoolkid. Start at 1800. Those books have half the data you need for almost anything."

Well, if you've never opened a volume of *Historical Statistics of the United States*, you don't know what excitement is. Two fat square tomes chock-full of charts, tables, and black ink.

"Wonderful, wonderful books!"

For each of Simon's claims that I checked, the data in those volumes were identical to his. Black infant mortality rates are declining, he says in *The State of Humanity*. And on page 57 of volume one of *Historical Statistics of the United States*, in Table B 136-147, under "Fetal Death Ratio; neonatal, infant, and maternal mortality rates, by race: 1915 to 1970," the precise same decline in mortality rates is presented in tabular form: from 180 black infant deaths per 1,000 live births in 1915 to 31 per 1,000 in 1970. Similarly, his figures for life expectancy correspond to those in the original sources. Same for air pollution.

So go ahead and check his data! Enjoy!

Some of Simon's other claims, however, are so far from received opinion as to be hard to take seriously – his view on species loss, for example, regarding which he asserts that "the highest rate of observed extinctions is one species per year."

That was hard to accept. Harvard biologist Edward O. Wilson, the guru of global species extinction, said in 1991: "Believe me, species become extinct. We're easily eliminating 100,000 a year." A year later, in his 1992 book *The Diversity of Life*, he had modified that figure somewhat, saying: "The number of species doomed each year is 27,000." Apparently, these numbers were a tiny bit slippery. Still, both of them were a far cry from Simon's "one species per year."

Simon, on the other hand, pointed out that the higher estimates did not come from observation, they came from *theory*, specifically from Wilson's own theory of "island biogeography" which correlates species extinction with tropical forest destruction. The theory's "species-area equation," supposedly, predicts that for each additional unit of forest destroyed, so many more species die out.

This was another mathematical argument, reminiscent of the one made long ago by Malthus, and it was exactly the type of Neat Mathematical Certainty that Julian Simon took so much joy in shooting big holes through, which is what he proceeded to do now. The problem with the theory, he wrote in a paper on species loss with Aaron Wildavsky, is that it is not borne out by the empirical facts.

"The only empirical observation we found is by Lugo for Puerto Rico, where 'human activity reduced the area of primary forests by 99 percent.... This massive forest conversion did not lead to a correspondingly massive species extinction.'" Simon quoted Lugo to the effect that "more land birds have been present on the Island in the 1980s (97 species) than were present in pre-Columbian times (60 species)."

Say again? The forest was 99 percent demolished, and the number of bird species actually *rose*?

Even for me, this was too much.

The forest was 99 percent demolished and the number of bird species actually *rose*? Say again?

The International Institute of Tropical Forestry, part of the US Forest Service, is located in an overgrown gray stone building in San Juan's Botanical Gardens. Ariel E. Lugo, a slim, gray-bearded man in a silver-green forest service uniform, is director.

He's also a world-class expert on tropical forests and species extinction. A native of Puerto Rico, Lugo was educated in San Juan through his master's degree, came to the mainland, got a PhD in plant ecology from the University of North Carolina at Chapel Hill, then taught botany for 10 years at the University of Florida. He spent two years at the Puerto Rico Department of Natural Resources and two more years on Jimmy Carter's Council on Environmental Quality in Washington, DC. Finally, he went back to San Juan as director of the Institute, a position he's held for the last 17 years.

"I see myself as in the middle of the road," he says. "On the right of me is Julian Simon, who sees nothing wrong. You know, 'We're doing just fine.' I don't want you to put me at that extreme."

Still, Lugo is not what could be called a major supporter of Wilson's theory of island biogeography, or of the species-area equation that forms its mathematical centerpiece. The equation is simple enough: $S = CA^z$ where S is the number of species, A is the area, and C and z are constants for the type of species in question, its location, and other factors. The apparent certainty it embodies, however, is an illusion, according to Lugo.

"The first uncertainty is that we don't know how many species there are. The margin of error is enormous: depending on who you talk to there is anywhere between 5 million and 100 million species, but science has described only a million species. How can you predict how many species are lost if you don't know how many species you're dealing with?"

The second problem is that the equation was never intended to describe *extinctions* to begin with. "It was a device for explaining the number of species on islands," he says. Generally, the bigger the island, the more species it has, other things being equal. But even if cutting down an island's forests causes species to leave the area, that's not the same thing as making those species extinct. "The presence or absence of a species in a particular area is one thing, whereas wiping out the genome of that species is another thing altogether – wiping out the seed, wiping out the mechanisms for hibernation, wiping out its dispersal, wiping out the management of the species. That's a completely different biology.

198 ►

602

books on getting more out of the Internet.

11

on carpal tunnel syndrome.

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Doomslayer

◄ 197

"And what is the relationship between deforestation and species loss to begin with?" he asks. "Do we understand that? Do we know that when you deforest an acre, you lose x proportion of species, *to extinction*? Well, I'm afraid that nobody knows that. There is not one study that can claim to have understood the relationship between deforestation and species lost *to extinction*.

"And so if you're an objective scientist," he says, "you cannot put a number to the rate of species lost. But I believe we're exaggerating the numbers.

"What's unstated in all this is that when you deforest, you go to zero, that you go to pavement. That's how I put it, that 'you go to pavement.' This is why people get mad at me, because at this point in my talks I show a slide of pavement, but the pavement has weeds growing through it. I can take you to places of abandoned roads in the rain forest that have *trees* growing out of them."

"It's the difference between a speculative analysis of what *must* happen and my empirical analysis of what *has* happened."

Trees sprouting from the asphalt! Birds perching on the branches, insects crawling, worms boring, bees buzzing, lizards walking, moss growing on the tree trunk!

"Look at the example of Puerto Rico," Lugo says. "This island has a documented deforestation rate of 90 percent, and it has a documented loss of primary forest of 97 to 98 percent. So here's an island that has lost in the past, in the *recent* past, up to the '50s - I was already born when the island was at the peak of deforestation - it's lost almost all of its forest.

"The first surprise is that there are more bird species here now than ever, in part due to the invasion of nonindigenous species. The second surprise is that much of the forest has grown back."

On Lugo's conference table is a book open to two photographs.

"Now, where I'm gonna send you today," he says, "is *here*."

He points to a road that winds through the western fringe of El Yunque, the Caribbean National Forest, the only tropical rain forest in the US national forest system. Picture One, an aerial photograph taken in 1951, shows the area on the west side of the road:clear-cut, mowed down, absolutely denuded of trees. It looks like stumps and dead grass. The east side of the road, by contrast, is deep, dark, and flush with vegetation, an untouched virgin rain forest.

Picture Two shows the same area 13 years later: from the aerial photograph, both sides of the road are identical.

"You can see that it recovered," says Lugo. "So, you take your car and you ride through these forests, and you tell me."

Puerto Rico Route 186 is not far away, about 30 minutes by traffic jam. The road is paved but unmarked, slightly more than a lane wide, just enough space for two cars to pass without the sound of impact. You drive toward the mountains, white clouds bunched above, isolated raindrops spattering the windshield, and in five or six minutes there's tropical forest on both sides. Tall ferns, flame trees, mahogany trees, humongous green leafy plants, plus massive clumps of bamboo - stalks that tower 20 or 30 feet overhead.

Julian Simon: The facts are fundamental.
Garrett Hardin: The facts are not fundamental. The theory is fundamental.
- from a 1982 debate with the UC Santa Barbara biologist

The doomslayer-doomsayer debate, Simon thinks, is an opposition between fact and bad theory, a case of empirical reality versus abstract principles that purport to define the way things work but don't.

"It's the difference," he says, "between a speculative analysis of what *must* happen versus my empirical analysis of what *has* happened over the long sweep of history."

The paradox is that those abstract principles and speculative analyses seem so very logical and believable, whereas the facts themselves, the story of what has happened, appear wholly illogical and impossible to explain. After all, people are fruitful and they multiply but the stores of raw materials in the earth's crust certainly don't, so how can it be possible that, as the world's population doubles, the price of raw materials is cut in half?

It makes no sense. Yet it has happened. So there must be an explanation.

And there is: resources, for the most part, don't grow on trees. People *produce* them, they *create* them, whether it be food, factories, machines, new technologies, or stockpiles of mined, refined, and purified raw materials.

"Resources come out of people's minds more than out of the ground or air," says Simon. "Minds matter economically as much as or more than hands or mouths. Human beings create more than they use, on average. It had to be so, or we would be an extinct species."

The defect of the Malthusian models, superficially plausible but invariably wrong, is that they leave the human mind out of the equation. "These models simply do not comprehend key elements of people - the imaginative and creative."

As for the future, "This is my long-run forecast in brief," says Simon. "The material conditions of life will continue to get better for most people, in most countries, most of the time, indefinitely. Within a century or two, all nations and most of humanity will be at or above today's Western living standards.

"I also speculate, however, that many people will continue to *think and say* that the conditions of life are getting *worse*."

But you don't have to be one of those people, one of those forever Glum and Gloomy Gusses. All you've got to do is keep your mind on the facts.

The world is not coming to an end.
Things are not running out.
Time is not short.
So, smile!
Shout!
Enjoy the afternoon! ■ ■ ■

Hard Drive

◄ 147

were 386s running at 25 MHz. Graphics and frame rates were correspondingly clunky, but the physics engine was as accurate as technology allowed. Since then, a MicroProse studio in Britain has produced two titles, both featuring Formula 1 driving: *World Circuit/Grand Prix Racing* in 1992, and a 1996 sequel, *Grand Prix II*. Meanwhile, Papyrus two-tracked it: *IndyCar Racing* in 1993, followed two years later by *IndyCar Racing II*; *NASCAR Racing* in 1994, then *NASCAR Racing 2* last year.

These are the hardcore sims. There are numerous other race-based titles, such as *Monster Truck Madness* and *Need for Speed*, but for the most part they are games or game-sim hybrids.

One weekend, I hijack my friend's souped-up Pentium PC, slip on some good headphones, curl my fingers around a joystick, and hit the track – *Grand Prix II*, *IndyCar Racing II*, and *NASCAR*.

First of all, god bless chip technology. If you've got the processing power, the graphics and frame rates of these babies are exceptional. Not arcade level yet, but darn near. I find myself leaning, bracing, and flinching involuntarily.

And cursing. At first I can't make it around the track even once without plowing into some immovable object. I bury my nose in the manuals, trying to figure out why. The short answer: everything's too real. If you're doing 120-plus with cold tires, the slightest twitch or miscalculation has metal-crunching consequences. And once you learn how to handle the speed, you have to start dealing with what happens when you race: your fuel depletes, your tires heat up and wear out, and (unless you check the option box that makes your car indestructible) any damage affects handling and speed.

Each program offers a garage setup with which you can modify your car in many ways, as well as a choice of tracks and track conditions. The driver also has complete control over what repairs and changes are made in pit stops. The manuals go into great detail about the effects of wheel stagger, tire pressure and temperature, wing angle, and assorted other racing technalia. You need to study them and do some time-consuming experimentation to devise a setup that can keep up with the preprogrammed AI competitors.

And then you have to get to know the track. I spent hours at the Monaco Circuit – one of 16 tracks offered by *Grand Prix II* – before getting the hang of half the turns. That bloody Loew's double hairpin shunted me into a wall every single lap.

This is not a learning curve. This is a learning wall. Who the hell has time for all this?

What it takes

Let's see: combined sales of more than 1.3 million copies of *World Circuit/Grand Prix Racing* and *Grand Prix II*; 420,000 copies of *IndyCar Racing* and *IndyCar Racing II*; 800,000 copies of *NASCAR Racing*. That's one heck of a lot of people with time on their hands.

And among these millions of virtual racers are a group that deserve to be singled out. *Enthusiasts* is just too pale a word to describe them. *Junkies* is more like it. They will spare no effort or expense to acquire whatever hardware or software brings them closer to the real thing. They will spend entire weekends in the virtual garage, tinkering with wheel camber, spoiler settings, and tire compounds. They will log thousands of laps on every racecourse available, nudging their lap speeds up by tenths of a mile per hour. They will, if necessary, neglect their jobs, friends, and loved ones. They will do whatever it takes to win.

That bloody Loew's double hairpin shunted me into a wall on every lap. This is not a learning curve. This is a learning wall.

Rhawn Black is one of them. Rhawn is a beta tester for Papyrus, and by all accounts a virtual racer to be reckoned with. I visit him late one afternoon in his Whittier, California, apartment to see him in action. With him is his good friend, another simhead, Greg Hans, a 41-year-old pool maintenance and repairman. We sit in Rhawn's spare bedroom, Rhawn in a desk chair in front of his steering wheel controller and computer, me on the edge of the bed, Greg standing or squatting awkwardly.

"Greg, have you tried this setup with 8 gallons of gas?" asks Rhawn without taking his eyes off the screen, which has a cockpit view of a stock car hauling ass around an empty track. This is *NASCAR Racing*. It's a cloudy day, and the grandstands are empty. In the turns, Rhawn is following the little skid marks he's left on previous laps. The speakers on either side of the screen throb with the raunchy roar of a large, un-Midasized engine turning over at high rpms.

Greg leans in and has a look.

"This is a kick-ass setup," Rhawn continues. "I knew that it was good for a full-race setup, but I didn't think it could be a 5 percent sprint car, and it's actually turning 154s." Greg turns around to inform me that for the Rockingham racetrack – the real one is in North Carolina – 154 mph is a damned good lap speed.

Rhawn, 28, an adjustable-rate mortgage specialist, is practicing for a race. He long ago did the necessary tinkering and experimentation to come up with the ideal setup for this particular track. Meaning he messed with gear ratios, cross-weights, tire pressure, shocks, and a few other variables, and took the car out on the track time and again to see what worked and what didn't. Since the coming race is only 5 percent length – about 26 miles, instead of the usual 400 – he's carrying only 8 gallons of fuel, to make the car lighter and faster.

Yes, the program is that sensitive.

While Rhawn keeps racking up the 154s, I ask about their shared interest.

"Obsession," Greg corrects me. "Obsession. To stay competitive, you have to log the hours. I can easily do three or four hours a day." I ask Greg if this gets him in trouble with his wife. Rhawn chuckles, and Greg just gives me a look.

"I don't know what Rhawn's laughing at. Ask *him* about it." So I ask him, and he points mutely to a piece of paper

200 ►

Hard Drive

◄ 199 taped to the cabinet above his computer screen. It is a weekly schedule, typed up by his fiancée, that allows him three sim hours on each of four different days. "Sunday is my day," it reads, "so back off!"

Today is not one of those days. I ask Rhawn if he ever held to the schedule.

"Nope."

Rhawn stops his car and asks if I want to try. I sit at the wheel, position my feet over the pedals, and get up to speed. And what a difference! This wheel is *nice*. It doesn't offer much resistance or any force-feedback – something a lot of people are working on – but it's a far sight more solid and reassuring than any of the arcade wheels I've encountered.

It also costs $500, pedals included. It's made by a small start-up in Minneapolis called Extreme Competition Controls Inc. and is the runaway favorite with simheads. Rhawn tells me that his cheaper plastic wheel controller broke after a month or two of hard racing; I hear similar complaints from other virtual racers.

I manage to turn one lap at 135 mph. Then I forget to shift into high gear and burn up the engine.

Greg took an extra step and bought a seat. Yes, for another $339.95, you can sit in a racing seat made by a company called ThunderSeat, and … vibrate. A powerful subwoofer under the chair transmits the rumble of your engine directly into your butt. Greg swears by it.

And if you think that's excessive, hold onto your helmet. Another small start-up called Interactive I/O, based in Orange, California, has just started offering a full racing cockpit, called Virtual Vehicle JD, with an authentic, adjustable racing seat, a real leather-wrapped Formula 1-style wheel with high-resistance steering, a monitor stand, and spring-loaded pedals that feel as close to the real thing as one could hope. List price: $1,295. PC and monitor *not* included.

Francis De Giorgio, who cofounded the company along with his brother-in-law, Erick Unbehand, lets me take one for a spin in his Irvine home. I ask him if $1,300 might not be a little much for a games controller. I mean, you can buy a car for that.

"It's a lot of money," he admits. "The price will come way down when we do larger production runs. But the demand is unreal. At this point, you have to beg us for a unit." They've built about 100 so far and have expanded operations from a garage to a space 3,000 feet square.

I ease myself into the thing and stifle the urge to reach for a seatbelt – one of the few real-car details it lacks. The seat is hard plastic covered with thinly padded vinyl; it's built for speed, not comfort. As I'm flying around a Formula 1 track in *Grand Prix II*, pedal to the metal, heart rate up and mounting, De Giorgio tells me a story I've already heard about five times: Jacques Villeneuve, the 1995 Indy 500 champion (see "The Ultimate Man-Machine Interface," *Wired* 3.10, page 124), recently went out to an F-1 track in Belgium that he'd never raced on before and walked away with the fastest qualifying time. When asked how he knew the track so well, he answered that he'd been practicing at home. On his computer.

"We sent Villeneuve a virtual vehicle unit," bubbles De Giorgio, who is at times so enthusiastic about virtual racing that he can't get the words out fast enough. "We got a letter back from Jacques's manager. He said, 'You are not allowed to use his likeness, or his name, or the Williams name, or any of the logos in any of your advertising or your promotional material. Could you send us another unit?' "

Back at Rhawn's apartment, I'm starting to get the hang of things. Or so I think. I manage to turn one lap at 135 mph before forgetting to shift into high gear and burning up the engine. One-thirty-five on this track is what's known as a losing time. Rhawn consoles me by pointing out that sim racing is actually more difficult than real driving, what with the limited sensory input and lack of weight shifting and g-forces.

Humbled, I ask Greg and Rhawn how they got hooked. Neither, it turns out, is much interested in computers. Their racing interest comes from racing. They both race little remote-control cars. They both follow the NASCAR circuit closely.

"Shit, 15 years I've sat there and watched every race," says Greg, running a large, calloused hand through his hair. "That's what's so good about this program. You can simulate what you've been watching all this time. It's part of the thrill." Neither of them has raced a real car, but both tell me that they would in a second, "funds permitting."

Speaking of funds, there's another cost that these two gentlemen and their fellow fanatics incur, and it dwarfs the price of hardware: phone bills. Connect time to Massachusetts is expensive. Both Rhawn and Greg admit to monthly phone bills in excess of $500, and they tell me that this guy named Keith is putting them to shame with bills of …

Oh, I'm sorry. Did I neglect to mention that Rhawn and Greg are *online* racers?

Other people

This is the missing piece of the puzzle. Yes, the graphics are great, the programs are extraordinarily sophisticated and realistic, and controllers are getting better and better. It's requiring less and less imagination to lose yourself in simulated speed. But that's only part of racing, isn't it? What about competition? And not this AI crap, predictable and therefore contemptible computer-controlled opponents. I mean *live* competition, against other human beings!

The same question occurred to Papyrus, the maker of *NASCAR Racing*. They did something about it.

In a climate-controlled room in Watertown, Massachusetts, lurks a daunting array of processing power. More than 30 top-of-the-line servers and 128 high-end Motorola modems on specially designed racks fill the 800-square-foot room, humming and buzzing 24 hours a day. This is the nerve center of Hawaii (no, it has nothing to do with the 50th state), a prototype online service that allows groups of up to 32 people with 9600-baud modems and a copy of *NASCAR* to race, live, against each other. After running in closed beta for nearly a year, it went to open beta in April 1996 and has been a roaring success.

Rhawn's going to show me what it's all about. He's already made short work of the AI-programmed competition in that 5 percent race. Now it's time for the real thing. He dials in to Massachusetts and chooses a race at Rockingham, which is scheduled to start in a few minutes. He checks out the competition in the pre-race "chat room." There's a list of names and numbers, and everybody's sending short messages to each other. The numbers represent each driver's ranking on a scale of 0 to 15: the more wins you rack up against worthy opponents, the higher your number. Rhawn is at 13. No one has attained 15 yet; there's only one guy at 14, and he's in this race.

Rhawn and Greg know just about every guy signed up for the race, if not personally, then by reputation.

"There's Nim, there's Mark Truman, he's a good racer, and oh my god who let *him* in here?" exclaims Rhawn, pointing to one of them. "Don't get me wrong, he's a nice guy to talk to, a friend, but the man just cannot drive."

The practice session starts. Seventeen cars pull out of the pit lanes, hit the track, and accelerate. At any given time, five or six vehicles are visible ahead. Some do swerves, to warm up their tires. Two or three more lurk in Rhawn's onscreen rearview mirror. He recognizes some of his friends by their paint jobs, which are customizable. On our side of the screen there's a palpable excitement in the air. These are real people; this is *live*. Jerk the wheel by accident, brake too hard, and you can send someone you know into a death skid.

"I have to make sure my fourth gear isn't redlining at the end of this corner down here," Rhawn says absently, lost in concentration. I notice that he's working the pedals in his socks.

His fourth gear is perfect.

Practice over, Rhawn pads out to the bathroom to make his own personal pit stop. The race he's about to join is a 50 percenter, meaning it's 200 miles and more than an hour long. There's no Pause option in an online race. You don't get out of your car until it's over.

Now it's qualifying time. Rhawn races around the track twice, alone, holding the line he's practiced for hours and hours to perfect. Simultaneously, 16 other guys across North America are looking at the same empty track zipping by under their tires. Only two of them, though, prove to be faster than Rhawn. He qualifies in third position.

Finally, it's gentlemen-start-your-engines time. After a pace lap at low speed, the green flag comes out and things happen fast. Rhawn races doorhandle to doorhandle with a car on his left, whose sleek nose keeps peeking into view and dropping back, then pulls away from him in Turn Two with a well-timed downshift. He creeps up on another car and drafts – lets the forward car break the wind for him while he gains speed and prepares to make his move. When he passes on the next straightaway, his opponent fails to hold his line and, at 140 mph, nearly knocks Rhawn off the track.

These are real people; this is *live*. Jerk the wheel, brake too hard, and you can send someone you know into a death skid.

"Damn, that guy is loose!"

For 10 minutes, Rhawn is a study in cool concentration, both hands on the wheel, shifting at precise places and precise rpms, relentlessly holding his line. Greg and I look over his shoulder, spellbound. Greg occasionally whistles softly in admiration.

There's a wreck somewhere on the track, and the pace car comes out. Lines of text in the upper part of the screen inform us that Number 61 is out of the race, and Number 73 has gone into the pits. Rhawn slows down, steers around scattered wreckage ("Ouch," says Greg), and gets in line behind the pace car.

"Pace lap in fourth gear, save that gas."

"That's a good idea," Greg says.

Fast company

Hawaii is just the beginning. This spring, Papyrus and its parent company and distributor, Sierra On-Line, in conjunction with NASCAR itself plan to launch the NASCAR Racing Online Series, NRO – a pay-per-play network with dialup local access numbers and assured lines, something the ordinary Internet as yet cannot guarantee.

NASCAR's involvement is not to be sneezed at. In 1995, 5.3 million people attended the 31 NASCAR Winston Cup Races. The organization hauls in an estimated $2 billion annually from TV rights, gate receipts, and memorabilia. Just by licensing its name, NASCAR can carry a whole product line.

And when it comes to supporting online racing, NASCAR's not just spinning its wheels.

"We currently have 12 racing divisions," says Blake Davidson, manager of marketing technology for NASCAR in Daytona Beach, Florida. He's talking about the real-car kind, from the top-of-the-line Winston Cup to the low-budget, local-level Winston Racing Series. "We intend to treat NRO online racing as the 13th division."

There are already plenty of sim racing leagues, but none that offer full-out, head-to-head competition. A cursory Web surf will turn up dozens of sites devoted to fans of every sim racing program; typically, members run their best time, alone, on a particular track under particular conditions, then send the record of their race to an administrator, who ranks them. In Hawaii, the ranking is automatic. And anyone can start a league – at last count, there were more than 30. The top leagues – one that Rhawn's in, for instance, features a "stress-test" entry requirement, in which "board members" box you in at high speed – exclude all but the most experienced racers.

But so far, none come close to what NRO intends to offer.

"We're looking at official, and officiated, races," says Davidson, "complete with

202 ►

Hard Drive

◄ 201

cash prizes, sponsorship, the works."

In other words, the parallel universe of racing simulation is about to intersect with reality.

Ed Martin, manager and series director for NRO at Papyrus, is a man with a vision. "Online racing is big, and it's about to get much, much bigger," he says. "And not just in terms of numbers. Eventually, we want to televise online races. We want to make these guys stars. Why shouldn't anyone with the capabilities have the chance to be as famous as real racers?"

It gets even better. "Imagine this," Ed continues. "Imagine that we take the winner of the online series, put him in a sim unit at the Daytona 500, and have him race against the real drivers *in the actual race*."

Remember Woody Allen's *Zelig*, which inserted him into historical situations by means of cinematographic sleight-of-hand? How about *Forrest Gump*? Exchange Woody or Tom Hanks for a hot-shit virtual racer and black-and-white archive footage for live TV, and you've got the idea.

For 20 minutes, the only sound in the room is the whine of the cars onscreen. Then, without warning, disaster strikes.

"We put positional sensors on the real race cars and digitize them into the sim, so the virtual racer has them on his screen. And we also insert the simulated vehicle into the live TV coverage, so fans can see how he's doing against Dale Earnhardt, Bobby Labonte, the top stock-car racers in the world."

Whoa. Do those stock-car racers really want the company?

I ask Bobby Labonte. Labonte drives real cars, real fast, for a living. Last season he won three Winston Cup races. At 32, he is one of the young lions of NASCAR. But Labonte's not one for flights of fancy. The marriage of virtual and reality? "Uh, don't know," he says simply in his clipped Southern accent. I ask him instead what he thinks about the simulation of his world, *NASCAR Racing*.

"Oh, I love it," he says warmly. "I mean, your seat don't move, you don't feel 700 horsepower, but it's very realistic. I was surprised that the tracks are as realistic as they are." Whenever his schedule allows, Labonte sneaks onto Hawaii online racing under an assumed name and pits his skills against 20 or 30 virtual racers. And he doesn't always win, either.

"Some of those guys are fine racers," he allows with gentlemanly respect.

Racing-sims have followed the exact opposite trajectory from flight-sims. The latter originated in big-budget military projects and commercial aviation, and later were adapted to the consumer market. Perhaps because cars aren't as hard to come by as airplanes, racing-sims were left to game designers – and then quickly got good enough to interest the pros. Labonte is only one of a growing number of racers who are integrating sim practice into their regimen. Other racers are even taking part in design consulting. Bryan Herta, a professional IndyCar driver, has been working with Interactive I/O to make the company's new "virtual vehicle" as realistic as possible. His favorite sim, unsurprisingly, is *IndyCar Racing II*. "To have a setup like this in your home, to me it's awesome," he enthuses. "I use it to brush up on tracks. I can go for hours at a time."

Meanwhile, virtual racers have no problem whatsoever with the idea of sponsorship and prize money. "Are you kidding? If I could make money doing this, I'd quit my job in a flash," says Lonnie Larkan, a 36-year-old air-traffic controller who lives in the desert hamlet of Palmdale, California. We're sitting in his racing room, which is dominated by two fresh new Pentium PCs with steering wheels in front of them. There's a signed poster on the wall of Dale Earnhardt holding a Winston Cup trophy and three neglected-looking guitars in the corner. Lonnie is one of Papyrus's original beta testers, one of the top four or five online racers – and therefore a prime candidate for stardom. "Between practice and racing, I do three, four hours a day, easily," he tells me in his Arkansas drawl, a gleam coming into his eye. "And for real stakes, you can bet I'd do more."

And practice does pay. Back at Rockingham, Rhawn Black, after coming out of the yellow flag, shoots to the front of the pack again. For about 20 minutes, the only sound in the nearly dark room (daylight's waning, but no one has reached for a light switch) is the whine of Rhawn's engine and those of the cars he smoothly sneaks up on and passes. We're all glued to the action. Then, without warning, disaster strikes.

"Oh man," says Rhawn, throwing his hands up. Greg curses explosively. Someone wrecked him – ran into him from behind and sent him into the wall. Onscreen, the world spins around and around sickeningly as Rhawn's car careens off one wall and then another. When it finally comes to a rest, there's a yellow flag out, and a tow truck appears, to haul the car back to the pits.

Rhawn hits a few keys and the perspective changes to a front view of his car. Ouch! The hood's torn off, and the right fender is bent up bad. He's going to be in the pits for a while. He uses the time to view an instant replay of the accident (the whole race is recorded and can be played back from any of 30-plus viewpoints, including "TV" and "blimp") and identifies the accident's perpetrator, car Number 36, which escaped unscathed. Scorn is heaped.

The dream

Why do people like Rhawn, Greg, and Lonnie do this? What is it about simulated experience that inspires such devotion, such resolute expenditure of so much time, effort, and money? Why has the pursuit of realism turned into a holy crusade?

The sociohistorical answer: Since the invention of the wheel, we have been developing more and more powerful and sophisticated technology, and using it to tame the world. So here we are at the end of the millennium, more or less masters of the material universe. We have flying machines, we have cordless phones, we have no-stick frying pans. Ho hum. What's next?

What's next is we use our technology to re-create the world, or create new worlds, for our own personal amusement. If you can't live it, simulate it.

A more prosaic answer is that it's about dreams and money. Rhawn Black, Lonnie Larkan, Greg Hans, and millions more will probably never have the opportunity to be a "real" race-car driver, however passionately they burn with the desire. The next best thing used to be television and an active imagination. Or a Camaro and a fistful of speeding tickets. No longer! Now, a relatively modest commitment in time and money will allow them to come closer to their dreams than ever before.

And closer, and closer.

The next frontiers in racing simulation are fast being settled. Ever increasing processing power and more powerful accelerator chips are allowing programmers, who are already ahead of the hardware curve, to create experiences that are visually and experientially closer and closer to being indistinguishable from reality. Physics engines are becoming sophisticated enough that software designers are talking about realistic rear-wheel locking and true-to-life high-speed skids and rolls. Expect photo-real scenery and cars (which exist in some sims already) and vast improvements in AI opponents soon as well.

No one will tell me when wraparound screens or truly workable VR helmets will hit the market, but no one seems to doubt that they will.

Then there's "force-feedback" – steering wheels that respond to the car. Pulling to the outside on corners, jerking if you drive over bumps – in short, behaving like a real wheel in a real race car. Some arcade games already have them, but they remain rather primitive, and so far nonexistent in the PC games market. But they're coming. Thrustmaster, which makes one of the cheapest and most popular wheel controllers on the market, is planning to release a force-feedback model in early 1997 for under $200, and both ECCI and Interactive I/O say they're ready to go – they're just waiting for the software companies to get with the program.

Although there are at least two driving-sim platforms that move like a commercial flight simulator, tip left and right, forward and back, they are not interactive and are just way too big and expensive for the consumer market.

So far.

What happens

In the meantime, back in Whittier (or rather, Rockingham), Rhawn Black has just about all the realism he can handle.

Seventy seconds after entering the pits, three laps down, he pulls out on the track, fighting his car's new tendency to pull right. A crumpled fender is visible through the windshield. He mutters something about trying to bend it back into shape using car Number 36, but it's only a joke – pros never intentionally wreck each other, and neither do top-level virtual racers like Rhawn.

With his hood gone and a fender crumpled, Rhawn has had just about all the realism he can handle.

When he gets up to speed, it becomes clear that the car's aerodynamics have changed drastically, and it's slowing him down.

"There's nothing I can do with this car," he says resignedly. "At least if I had hood over my engine, I could turn 150s." Even with this disadvantage, though, Rhawn pulls closer to lesser drivers in the turns, where skill is everything. But in the straightaways, he's left behind. All the skill in the world isn't going to win him this race.

Greg is still grumbling darkly about the jerk who wrecked Rhawn, and even I'm outraged at the injustice of it all. But to my surprise, Rhawn seems unperturbed.

"This is real racing, guys," he chides us, still not taking his eyes from the screen. "In real racing, this shit happens." ■ ■ ■

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Lifestreams

◀ 150

how it's explained, the result of academia's distaste for UI is clear. As Card points out, "The classic work on user interfaces that sets the current paradigm was invented outside of universities in industrial research laboratories and government-funded institutes."

So why is David Gelernter, one of the leading lights in CS academia, suddenly hip-deep in soft science? Ask a professor who knows him only by reputation, and chances are he or she will blame the Unabomber. Almost four years ago, Gelernter received a package from the Unabomber; it blew off part of his right hand, caused massive chest injuries, and put him in the hospital for several weeks. That, some suggest, could make anyone reexamine their mortality and even do something crazy like become a poet – or an interface designer.

But the real answer is more complex and less personal. Gelernter always had an interest in subjects outside of the strictly technical. He majored in religious studies as an undergrad at Yale and was in the middle of writing *The Muse in the Machine: Computerizing the Poetry of Human Thought* – a book that attempts to explain human creativity – when he received the Unabomber's missive. The real story is that Gelernter is turning to "soft" computer science because, once again, he is ahead of the curve. He is making CS relevant to the 21st century.

Given the current hype over everything digital, that may sound crazy. How could CS *not* be relevant in the next century? But the reality is that CS academia was a creation of the Cold War, and in the age of Netscape and Microsoft it's as out of place as an MX missile. As Peter Denning, the computer science department chair at George Mason University and one of the wise old men of the field, puts it, "The old days when we could just go into the back room and develop technology for the DOD are gone. Now we're developing technology for my mother, and that requires a whole new set of skills."

"The old days are gone. Now we're developing technology for my mother, and that requires a whole new set of skills."

Today, industry is driving the field, and academia is becoming increasingly irrelevant. That's why, when asked about the state of CS, David Gelernter leans back behind his cluttered desk and paints a stark picture.

"For years, computer science has been struggling with antiquated Unix applications when all you had to do was open a MacWarehouse catalog and see applications with 10 times the sophistication of what we were using," opines Gelernter. "For years, computer scientists were treating operating system design as sort of an open-research issue, when the field's direction had been decided by commercial operations. *Computer science has become completely cut off from reality.*"

The problem, he continues, is not only the fault of military funding and its warping effect on academic priorities. It's that academics have not been able to keep up with the terrifying exponential curve that has taken us from the ENIAC to the SGI Indy in 48 years. This is why, Gelernter says, about a quarter of the academics object every time he gives a presentation about Lifestreams, because it won't "scale." They insist that as the number of Lifestreams users grows, the system will have greater and greater computational and storage requirements than can possibly be met.

"Computer science is absolutely lost in a world of abundant power. Academics are still terrorized by issues of scaling. The whole field hasn't gotten to the other side of the moving wave of history. They are still on the resource-conservation side, and it's the other side – the creative, resource-squandering side – where the future is. People are reluctant to go there because they're worried about being criticized for having science fiction scenarios, having their heads in the clouds, not being serious engineers. But that's the intellectually interesting place to be."

Gelernter's grandiose rhetoric and pipe-smoking affectations sometimes remind me of an aging parent in a black leather jacket – he's making a stab at becoming something he isn't. But if computer science is going to shed its old, tired traditions and become a discipline that helps propel the next century, it's going to require professors like David Gelernter and projects like Lifestreams.

The trouble with desktops

Which is not to say that Gelernter came up with the Lifestreams project out of some altruistic and purposeful effort to save computer science – he is also trying to save himself. Save himself, that is, from the steady stream of information that flows into his office and threatens to drown him.

The state of Gelernter's office is discussed by his grad students the way most people discuss the weather. "How many inches?" one asks another, referring to the depth of newspapers, technical preprints, and other academic detritus that covers the carpeted floor. His desk is even worse; it is littered with piles of books that almost entirely obscure the man behind the desk. Clearly this is not someone who would place much confidence in the idea of the "desktop metaphor." Indeed, Gelernter admits that his electronic file system is just as cluttered, just as disorganized, as his physical space.

For Gelernter, this situation reflects an abject failure of technology. A failure that he has no choice but to rectify. With a weary wave of his hand, as if to reflect the unpleasant duties that even the most brilliant minds must sometimes stoop to, he says, "As consumers of computing, we had a responsibility. It had reached the point a few years ago when the tools I had available for organizing my electronic life were wildly, desperately inadequate. I was wasting too much time, and something had to be done."

I would have been tempted to reply with something to the effect of "a wise man doesn't blame his tools," except that recently I had been hearing similar sentiments from other UI researchers. Even Don Norman, an interface guru and fellow at Apple Computer, the true home of the desktop metaphor, had bluntly told me, "The desktop is dead."

The problem, Norman said, is that the desktop has outlived its usefulness. "The desktop worked very well on the old 128K Mac with no hard disk. You could scatter everything around and still see it on the screen. But today we have thousands of thousands of items – more than can possibly fit on the screen."

Perhaps this state of affairs should come as no surprise. In an industry in which obsolescence is measured in days, the desktop metaphor has exhibited astonishing longevity. It made its first appearance on the Xerox Star, developed at Xerox PARC during the late 1970s, where overlapping document windows could be moved around like pieces of paper on the screen. The idea was refined in 1982 and enhanced for Apple's Lisa computer, which used icons to represent files and allowed users to move these icons around the screen and into folders.

At the time, the desktop metaphor was truly revolutionary. It was the visual representation of the secret world of bits. Users saw their files as objects that really existed. And by deciding where to position their files, users could classify them – those located at the top of the screen were the ones to be dealt with first, for example.

But, points out Gelernter, this was "before the Internet in its modern sense, before the explosion of email, before systems had been accumulating files for a decade. Today the desktop is just crazily obsolete. We would consider it ridiculous for people to be routinely driving around in 20-year-old automobiles. Why are we doing it with user interface?"

In trying to answer that question, I found myself digging through musty academic journals in search of alternative methods for organizing our electronic lives. What I turned up was astonishingly sparse. Proposed replacements for the desktop are few and repetitive. I came to lump them together in three categories: spatial, semantic, and networked.

Spatial is the largest by far. Stretching back to 1976, when Negroponte and three others proposed the Spatial Data Management System, researchers have been captivated by the dream geography of data space. They all face the same problem, however, that has rendered the desktop obsolete: scaling. How do you represent such a huge space on such a small screen?

In trying to address this problem, researchers have come up with some fairly clever techniques. For example, George Furnas, formerly at Bellcore and now a professor at the University of Michigan's School of Information, pioneered the idea of "fisheye views," which show distant objects at a smaller size – allowing more icons to be packed onto a screen. At Xerox PARC, Stuart Card and others developed "cone trees," a very efficient method of viewing large hierarchies that works by mapping trees onto three-dimensional cones that can then be rotated by users. While these schemes are vastly better at showing information than the current 2-D desktop, they suffer from problems of their own. Change the position of a file in a cone tree, for example, and the whole tree must be rejiggered, causing users to lose their bearings.

A second, much smaller, group of research has focused on semantic organizations. Instead of sorting files in terms of folders and location, these schemes organize files by content. It's similar to how search engines such as AltaVista and HotBot organize the Web. The best example of this was a short-lived project at MIT called the Semantic File System, which eliminated the directories in Unix and replaced them with means to efficiently address files by their content. It's a compelling solution – I find myself using the Mac's Find command more and more as my hard drive grows – but a bit unwieldy for most uses.

The third type of organization is represented by Vannevar Bush's Memex, Ted Nelson's Xanadu, and today's World Wide Web: documents are organized in relation to other documents by means of links. This kind of networked organization allows for far richer structures than the simple tree hierarchy formed by folders on a desktop. If Microsoft's recent announcements about integrating the Web into the OS pan out, we may soon see a hybrid of these two schemes. Unfortunately, that will only make things more confusing: the classic problem of becoming "lost" in hyperspace will be combined with the visual shortcomings of the desktop.

The key to effective recordkeeping "lies in being able to determine not only the content but the context of a record."

Lifestreams

And then there is Lifestreams. (Despite the seeming obviousness of using chronology as a central organizing principle, Lifestreams' only real predecessor is a proposal published by British psychologist Mark Lansdale in 1992.) Unlike spatial and networked schemes, which require users to come up with their own, highly arbitrary classifications, and unlike semantic schemes that place the burden on the computer, chronological ordering is clearly defined and unarguable. There is no worrying about whether a document belongs in the Letters folder or the New Project folder. It simply takes its rightful place in the time-ordered stream.

Finding documents is easier, too. Instead of following links or guessing keywords, we can simply scroll back in time, using our memory for hints. "Hmm, I remember writing that letter after getting back from Japan." Even better, when we find the document, we also find the surrounding context. Eric Freeman, the Yale PhD who has implemented all of Lifestreams, likes to quote Terry Cook, director of the Records Deposition Division at the National Archives of Canada, to show why this is important. Cook states that the key to effective recordkeeping "lies in being able to determine, sometimes long after the fact, not only the content but also the context of a record in question." And Cook has studied cases in which lack of context made electronic records useless.

Finally, chronological ordering underlies many types of information, making Lifestreams incredibly general and flexible. Not only does it organize your files, it organizes your email. Lifestreams can also act as a calendar by attaching notes to future dates on your lifestream. Visiting a Web page? A card with that URL will be automatically placed into your stream. Even movies that you watch fall into the Lifestreams paradigm: each video frame is a card in the movie substream.

It should be clear that Lifestreams is much more than a file system with time and

206 ►

Lifestreams

◄ 205

date information. It's not like using the Mac Finder with the View by Date option selected. Instead, it's an entire architecture that defines the structure of our lifestreams, how they are stored, and the operations that can be performed on them. It is, in Gelernter's words, "a *cyberstructure* – a data structure that lives on the network."

This reliance on the network is important because it addresses the most common objection to Lifestreams: scaling. How can someone's entire lifestream – ideally starting with that person's birth certificate and including every email they have exchanged and every document they have read or created – be stored on their hard drive? The answer is that it can't. Each person's computer acts as a cache for their lifestream, storing only the most recent documents. Older parts of the lifestream are archived on some server across the network, accessible on demand. Even this will require massive resources, but Gelernter's group feels confident that it will be able to ride the historically steep decline in the cost of mass storage to success.

> **"Every now and then, Lifestreams helps you manage information transactions that you wouldn't have been able to do any other way."**

But it's the five basic operations that are permitted by Lifestreams' architecture – Find, Squish, New, Clone, and Transfer – that really define the system. Find allows the user to enter some criteria, such as keywords of a message title, and then creates a substream of all the entries in your lifestream that meet these criteria. This essentially adds a semantic capability to the system, creating the equivalent of subject directories on the fly. Squish takes a substream and then compresses it, in some content-dependent way. For example, performing a Squish on a movie substream would play the movie. A Squish on a series of stock updates might display a graph of the stock's price over time. This is the most powerful of the basic operations and the most open-ended.

New simply creates a card in the lifestream, and Clone makes a copy of an existing card. Transfer allows a card in one lifestream to be moved to another stream and is essentially a communications operation. To send email with Lifestreams, you transfer a document card from your lifestreams to the recipient's.

Right now, Lifestreams works only on Unix workstations (although Eric Freeman is currently porting the system to Java to make it platform-independent). So while I wasn't able to use Lifestreams to organize my day-to-day electronic existence, I did spend some time at Yale getting the feel of the system. And despite its rather clunky graphical interface – normal for a research project – I found it profoundly appealing. Most notably, I discovered that being able to scroll back through all my documents – whether Web pages or email – provided a very satisfying feeling of being in control, of knowing that everything was *still there*. That doesn't happen with the desktop. With my Mac, I know about the few files I commonly use, but the rest are buried in folder hierarchies, lurking in places that I haven't explored and no longer remember – they have essentially fallen off the edge of my virtual world.

The client-server model of Lifestreams, whereby most of your data is stored on a remote machine (the server) and your local computer serves only as a cache, also seemed well-suited to how most of us work. I could log in from my Mac at home, my IBM at the office, or my Newton on the road (yes, they initially developed a Newton interface) and still have access to all my files. However, some may find the idea of storing files on a remote machine that isn't under their control a bit disturbing. Gelernter and Freeman promise that encryption will be used in a production version of Lifestreams to protect users' privacy.

What I couldn't tell is if Lifestreams truly succeeds as the next-generation interface. Success, of course, is tough to define for something this general. Certainly it must be better than the current desktop paradigm. But what is the real goal? When I ask Gelernter, he is pointed and succinct: "Every now and then, Lifestreams helps you manage information transactions that you really wouldn't have been able to do any other way. But mainly, Lifestreams cuts down the friction. It makes life less of a nuisance. It makes the overhead go away. And really, the only thing that matters to a person in the end is to have the time – the little time that he's got – and use it the way he wants. That's the whole objective right there: not wasting time."

Evaluating Lifestreams

All of which sounds very good, but it begs an even harder question: How do you measure that?

Deciding whether Lifestreams is successful will determine its fate, but figuring out how to decide will determine the future of computer science. Because right now, nobody even knows where to begin.

Back when I was a computer science grad student studying parallel computing – just a few years ago now – determining the success of someone's research was terrifyingly black and white and followed a standard pattern. Someone would give a talk about a software application that they had parallelized. They would drone on and on while nobody paid attention until they reached the final part of their talk: *the speedup curve*. This is a simple line graph that shows how much faster a program runs based on how many processors it uses. Suddenly, everyone would wake up. If the line graph showed that on, say, 32 processors the program ran about 30 times faster, then the project was very successful. If it ran only eight times faster, it was a failure.

That kind of empirical, quantitative evidence has served computer science well. It has allowed us to stay on the exponential curve of improvement mandated by Moore's Law. But it simply doesn't work once the vagaries of human behavior enter the equation. This breakdown is palpable. When Eric Freeman gives talks about Lifestreams – his PhD thesis – none of the other professors at Yale are sure how to judge it. *Where's the speedup curve?* Suddenly, the whole academic model of CS breaks down.

Of course, there are plenty of other fields outside of engineering that must face this problem. The question becomes which one makes the most sense to emulate. And this is where those involved in user interface research separate into two warring factions: the social scientists versus the artists. The social scientists are those who believe computer science needs to become more like cognitive psychology and ethnography. They believe that empirical data, in the form of rigorous user studies, can be gathered and used to evaluate design decisions. The artists, on the other hand, see any attempt to inject quasi science into what is essentially a creative act as worthless. David Gelernter falls squarely into this latter camp.

"We definitely don't want CS to become like sociology," he begins. "We want to become like architecture, design, or music. Social science can disappear from the universe, and nobody would mind. But art has its own standards that are hard and rigorous. They happen to be subjective, ultimately aesthetic and emotional, but they can be tremendously serious. The problem with sociology is pretending that it's science when it's not. Architecture doesn't pretend to be what it's not. It says, Here is a building. What we try to do is make it beautiful and powerful."

It sounds like a radical position, but it is echoed by people such as Alan Kay, the acerbically opinionated researcher who is largely responsible for inventing the desktop metaphor while at Xerox PARC. His rant on the subject almost exactly parallels Gelernter's, except that he uses musical training – with its emphasis on performance and practice instead of dry academic theorizing – as the model that computer science should emulate.

"If you look at universities in the US, you'll find both musicology degrees and performance degrees. Musicology degrees are like computer science degrees – they are based on papers and analysis, and have very little to do with actually creating something new. But performance degrees are what CS degrees *should* be like. They train people with the skills you really need."

If you want to see the contrasting assumptions and results of this rhetorical warring between artists and social scientists, look no further than the recent exchange between David Gelernter's colleagues and Bonnie Nardi in the pages of *Computer-Human Interaction Bulletin*.

Nardi is a tall, sober-looking researcher at Apple Computer and an anthropologist (her PhD involved a computer simulation of bands of hunters and gatherers). While developing an intelligent agent product for Apple, she headed a small experiment to study how users organize and find information. By watching about 15 people do various tasks on a Macintosh and a Windows machine, they found that users rely on visual, spatial cues to locate files and found that few users relied on old, archival information. Both of these findings, they pointed out in a July 1995 paper, were clear support for the desktop metaphor. What they didn't mention, although they could have, is that the findings were also arguments against Lifestreams.

In a rebuttal paper published in the same journal five months later, Freeman and his colleagues challenged the Apple team's conclusions. *Of course* they discovered that people relied on visual cues, Freeman's team pointed out, because that's all that is available on Macintosh and Windows PCs. It would be like studying people listening to the radio and deciding that they didn't want pictures. As for the assertion that most people don't need archival information, says Gelernter, "this is the sort of observation that intuitively seems wrong, but as you think about it more … it seems even more wrong." That "most people" doesn't include gardeners who need to know which peas and zinnias tend to do well and keep logs to that end, or stock investors who need to know how a company tends to behave, or people whose cars sometimes break and need to be able to recall that when they heard a noise seven years ago the car was about to break, et cetera.

"We definitely don't want CS to become like sociology," Gelernter says. "We want to become like architecture, design, or music."

Unsurprisingly, no real conclusion has been reached in this debate: Nardi has written a rebuttal to Freeman's rebuttal to appear in a future issue of the bulletin. Freeman's team says it'll publish a rebuttal to *that*. But the debate illustrates the limitations of both approaches. Nardi's research was very effective in revealing how people use the current desktop, but the findings were extrapolated further than they could really go. As Nathan Myhrvold, Microsoft's technology guru, points out, "Doing user testing is a fine thing, but it doesn't help you create. It's the difference between being a proofreader and being a writer."

On the other hand, proofreaders definitely have their place, and there is a consensus among the user interface researchers I spoke with that Gelernter's ideas could use a little more copyediting. As Don Norman, the Apple fellow and cognitive psychologist puts it, "Gelernter is a brilliant man and very logical, but he doesn't know human memory." While it's true, Norman says, that people often remember things with temporal clues, this is just one of many ways – and not necessarily the best way. "The proper solution," he says, "is multiple solutions." This was a line echoed by nearly everyone. Agrees Jakob Nielsen, a user interface researcher at Sun Microsystems, "The temporal dimension is very important, but you cannot just do a time-based interface – it would be as bad as today's spatial interface. People are multidimensional."

Gelernter rebuts these objections by pointing out that Lifestreams *is* multidimensional: it has the Find command that allows for other searches based on keywords or tags. True – but both of these dimensions are profoundly nonvisual. Given that 70 percent of human input capacity is through our eyes, this seems like a serious shortcoming. Nonetheless, as Gelernter is fond of pointing out, this discussion is in some ways moot. Because, thanks to the revolution that is shaking CS academia, there is a new metric for evaluating work: the marketplace.

The invisible hand

Computer science has traditionally been richly funded by government largess. While grad students in other departments

208 ►

Lifestreams

◄ 207

fight for TA positions to pay tuition, computer science students at top universities are almost always supported by money from Arpa, the NSF, or other government grants. The downside, of course, is that computer science research has been bent to the needs of nuclear simulations and the like.

"Lifestreams is, in academic terms, very, very unfundable," admits Gelernter, almost proudly. "It's not what scientists are supposed to be worrying about at all." So, in a twist that is becoming increasingly common, Gelernter looked elsewhere for funding. He turned to venture capitalists. The outcome, he says, has been astonishingly positive. "It has been a real eye-opener for us to discover how much easier it was to make Lifestreams a reality in the commercial world than in the academic world."

Gelernter and Eric Freeman have formed an independent company backed by private investors to create and market Lifestreams. They plan on shipping the first Java alpha version of the product before summer's end. And although they admit that there is pressure on them to move the company out to Silicon Valley, for now it remains based in New Haven, near Yale.

Lifestreams shows how valuable chronological ordering can be – while showing that chronology by itself is not enough.

Of course, there has been the predictable hand-wringing about this commercial trend from some quarters. The standard objection is to point to the Arpa-funded creation of the Internet and argue that something like that just wouldn't happen in a market-driven world. Even if you ignore that Ethernet – which was as important to the growth of the Internet as TCP/IP – was developed by Xerox, this argument rings false.

Peter Denning points out that "when we think back over the major advances in technology that created previous eras and the famous names that go with them (e.g., Edison), we see that they were entrepreneurs and did what they did at the indulgence of their companies or with their own resources. There was no such thing as government funding. We had an explosion of technology then, and I see no reason we cannot have another explosion in the years ahead."

Which isn't to say that there aren't dangers. Students at UC Berkeley talk about how, the atmosphere of the department changed noticeably when Professor Eric Brewer recently turned his search-engine research into a commercial product. Suddenly, those students who were working on the system became secretive about their research. Similarly, when Pattie Maes at MIT formed Firefly, one student's thesis was embargoed to keep the inner workings of Firefly private. But while these types of events are disheartening, they are also self-limiting. Those who put commercial interests first will find themselves dismissed from academic circles because they have failed to meet the canonical rule: publish or perish.

Just as important, industry has plenty of reasons to make sure academia stays around. Myhrvold, for example, is hugely supportive of academic research, despite the fact that Microsoft has its own advanced research group. "Why do we need academics? Because we can't hire the world. That's why we present papers at Siggraph and try to support university research: to tap into the global brain."

Coda

For now, Lifestreams' future as the next user interface is as uncertain as the rifts in computer science it runs through. As Gelernter points out, "With something like Lifestreams, we won't be able to make any believable assertions about its having worked or not for a decade."

The program should find success in certain vertical markets – such as medical recordkeeping. It makes a lot of sense for a patient's digital record to be seen as a chronological stream of X-rays, prescriptions, and diagnoses.

Although this chronological approach is too one-dimensional for general applications, Lifestreams serves as an important proof of concept. It shows how valuable chronological ordering can be – while showing that chronology by itself is not enough. And pieces of it will most likely be incorporated into whatever *does* end up killing the desktop.

In short, Lifestreams will have done exactly what all research projects should do: take one idea and stretch it to an extreme. The result may not be suitable for the marketplace "as is," but it certainly bares the idea's strengths and weaknesses.

So how can computer science as a discipline encourage "soft" work like this without losing its rigor and empirical foundations? It can either be torn asunder by the debate between the scientists and the artists, or it can gracefully divide. Just as engineering has gone through a process of mitosis over the years – begetting materials engineering, civil engineering, et cetera – so will computer science.

"Computing has gone from something tiny and specialized to something that affects every walk of life," points out Myhrvold. "It doesn't make sense anymore to think of it as just one discipline. I expect to see separate departments of user interface, for example, to start emerging at universities."

He's almost certainly right. In an influential paper titled "The Computer Reaches Out: The Historical Continuity of Interface Design," Jonathan Grudin of UC Irvine half-seriously compares the development of computers with human development. "In a manner somewhat similar to a growing child, the computer is reaching out into its environment," he argues.

Initially, computer development focused on basic physical functions – hardware. This "computer-infant" interacted only with its parents, the engineers. As it became more accomplished, it expanded its reach with software and peripherals. It learned enough of a primitive language that programmers could teach it to do new tasks. Now, concludes Grudin, computers are reaching out to individuals who are less inclined to adapt to them – end users.

This new stage of computing requires very different pedagogical skills from those possessed by engineers and programmers. Like its offspring, it's time for computer science to grow up. ■ ■ ■

Haraway

◄ 159 polymorphous object of belief, knowledge, and practice." The immune system is a perfect example of the networked consciousness of the cyborg age. It's also a good example of what Haraway means when she denies there's any such thing as the abstract. In the end, her work and her life, her friend's death, and theoretical biology are all tangled together: a messy web of personal pain, politics, and science.

By the late '70s, Haraway was at Johns Hopkins teaching the history of science and thinking about apes and the people who study them. "At that time," she remembers, "primate behavior was a matrix for all kinds of debates about aggression, sexual violence, dominance, and hierarchy." As she wrote in *Primate Visions* (1989, Routledge), the book that came out of her academic work at the university, "The commercial and scientific traffic in monkeys and apes is a traffic in meanings, as well as animal lives."

Haraway is as complicated, as messy in her allegiances and interests as we could wish for in a witness to the cyborg age.

Primatologists, she argues, are working in the "borderlands," where the differences between animals and humans are defined - differences that are messier than people think. If apes are not fundamentally different from people, then our feeling of righteous superiority over animals may be based on thin air. And since primates are our close evolutionary cousins, their behavior may contain significant clues to the development of our own - or serve to mirror our view of it.

Often, primatologists' pictures of ape society contain covert justifications of a particular human, social, or political model. Male primatologists often showed these societies run by powerful males with female harems; a later generation of female primatologists found very different forces at work. As always, politics is threaded through the most objective science. "Primates," Haraway remarks, "are a way into thinking about the world as a whole."

The state of people

Haraway finally wound up teaching at UC Santa Cruz. After the conservatism of Baltimore and Johns Hopkins, California came as a relief. "It was like coming home," she laughs, recounting a bizarre story about a radical birthing group and a placenta-eating ceremony. "I understood I was in my community. These were folks who would understand the craziness of it all." It's an oddly moving thing to say. Haraway is faced with a world of warring factions, colliding ideologies, clashing oppositions: the state and the people, gay and straight, capitalism and communism, human and animal, people and machines. It is all, of course, completely crazy. She has a habit of describing the unlikeliest people as "folks," so you get "the folks at the Pentagon" and "the folks fighting the Vietnam War." The cyborg idea may in the end be Donna Haraway's way of showing us how to let folks be folks, rather than carving them up into cruel, arbitrary divisions. And with that, Healdsburg suddenly seems the perfect vantage point from which to observe the madness of the modern world.

So Donna Haraway sits on the porch, sips a beer, and pets her elderly cat, which recently had a run-in with a raccoon. She's as complicated, as messy in her allegiances and interests as we could wish for in a witness to the cyborg age. If we're going to build a humane technoculture, instead of a Kafkaesque nightmare, we would do well to listen to what she has to say.

"Technology is not neutral. We're inside of what we make, and it's inside of us. We're living in a world of connections - and it matters which ones get made and unmade." ■ ■ ■

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Cyborg Ancestry

◄ 159

tons with built-in autonomy."

All of which winds the story back to one man's personal science and the beginnings of the Cold War.

Norbert Wiener wrote *Cybernetics, or Control and Communication in the Animal and Machine* in 1948. The book was nothing if not ambitious. Wiener, an MIT mathematician, saw amazing similarities between a vast group of different phenomena. Catching a ball, guiding a missile, running a company, pumping blood around a body – all seemed to him to depend on the transmission of "information," a concept floated by Bell Laboratories' Claude Shannon in his founding work on information theory. More specifically, these processes seemed to depend on what the engineers had begun to call "feedback."

Wiener took the name cybernetics from the Greek *kubernetes*, meaning "steersman," and the image of a classical helmsman, hand on the rudder of a sailing ship, perfectly captures the essence of his idea. Palinurus, approaching the rocks, gets visual information about the ship's position and adjusts course accordingly. This isn't a single event but a constant flow of information.

Palinurus is part of a feedback loop, his brain getting input from the environment about wind speed, weather, and current, then sending signals to his arms to nudge the ship out of danger. Wiener saw that the same model could be applied to any problem that involved trying to manage a complex system and proposed that scientists use the same framework for everything.

Wiener's followers saw cybernetics as a science that would explain the world as a set of feedback systems, allowing rational control of bodies, machines, factories, communities, and just about anything else. Cybernetics promised to reduce "messy" problems such as economics, politics, and perhaps even morality to the status of simple engineering tasks: stuff you could solve with pencil and paper, or, at worst, one of MIT's supercomputers.

The cyborgmakers were in the business of making Wiener's ideas flesh. For them, the body was just a meat computer running a collection of information systems that adjusted themselves in response to each other and their environment. If you wanted to make a better body, all you had to do was improve the feedback mechanisms, or plug in another system – an artificial heart, an all-seeing bionic eye. It's no accident that this strangely abstract picture of the body as a collection of networks sounds rather like that other network of networks, the Internet; both came out of the same hothouse of Cold War military research.

Wiener's dream of a universal science of communication and control has faded with the years. Cybernetics has given rise to new areas like cognitive science and stimulated valuable research in numerous other fields. But almost no one today calls themselves a cyberneticist. Some believe that Wiener's project fell victim to scientific fashion, its funding sucked away by flashy but ultimately pointless AI research. Others think cybernetics was killed by the basic problem that the nuts-and-bolts mechanisms of control and communication in machines are significantly different from those in animals, and neither are very like control and communication in society. So cybernetics, which was based on an inspired generalization, fell victim to its inability to deal with details. Whichever perspective is true (and as with most such stories, the truth is likely to be a mixture of both), cybernetics has left two important cultural residues behind. The first is its picture of the world as a collection of networks. The second is its intuition that there's not as much clear blue water between people and machines as some would like to believe. These still-controversial concepts are at the bionic heart of the cyborg, which is alive and well, and constructing itself in a laboratory near you.

The '90s cyborg is both a more sophisticated creature than its '50s ancestor – and a more domestic one. Artificial hip joints, cochlear implants for the deaf, retinal implants for the blind, and all kinds of cosmetic surgery are part of the medical repertoire. Online information retrieval systems are used as prosthetics for limited human memories. In the closed world of advanced warfare, cyborg assemblages of humans and machines are used to pilot fighter aircraft – the response times and sensory apparatus of unaided humans are inadequate for the demands of supersonic air combat. These eerie military cyborgs may be harbingers of a new world stranger than any we have yet experienced. – *Hari Kunzru*

Lucas

◄ 166

Many people further believe that their informational image, so to speak – say, their address – should also be just as private. Do you think others should need my permission to use my name and address?

I think so, but the one that gets abused most, actually, is the image. That people should own their own image, which is true in the most primitive cultures, is something we've given away. It's just become a cultural thing. Obviously, the electronic media would go nuts if you couldn't take people's picture without asking permission. But how do you rationalize a supermodel who makes her living posing for pictures at $5,000 an hour, yet the paparazzi can come along and take her picture and then turn around and sell it for, say, $50,000 to the cover of *People* magazine, and that's legal. And you don't need to pay her.

Computers make this more fascinating because someone could create a working model of your face, that is, a 3-D virtual likeness of you. The artist would have spent a lot of time doing it, so they would think they own that likeness, and you, as the subject, might think you would own it.

Unfortunately, in this country the issue is where does it go? If you put it on the show *Friends*, you'd get sued. But you wouldn't if you put it on *Entertainment Tonight*, which is considered news. And what is the difference between those two shows? Nothing.

Are you surfing the Web these days?

When I'm interested in something, I'll look it up, but I don't have time to just spend on the Web.

So do you think there's anything worth paying attention to on the Web, or is it just a fad?

I think it's very important. It's a great asset for education and for school and for anybody doing research. The social aspects of it are very interesting. It's a kind of new town square – a place where people go and meet. Our society doesn't foster that kind of thing, which was the center point of most communities 100 years ago. The Net, I think, is renewing that whole concept of social interaction.

Are you using the Net in that way?

Not very much. Again, my issue is I've got a lot of stuff that goes on in my life.

Do you use email for that?

No. No. For being sort of a state-of-the-art guy, my personal life is very *un*state-of-the-art. It's very Victorian, actually. I like to sit on a porch and listen to the flies buzz if I have five minutes, because most of my life is interacting with people all the time. I interact with a couple of hundred people every single day, and it's very intense. I've got three kids, so I interact with them whatever's left of the day. The few brief seconds I have before I fall asleep are usually more meditative in nature.

When you were growing up, films were something that everybody stood in line for. Of course, these days, with big screens in our houses, the crowds are going to be hard to replicate. Do you think that's a big deal? Will we lose the association of movies and a crowd of other people?

I don't think we will. That's the experiment I'm doing with reissuing the *Star Wars* trilogy. What we're doing is to say, "Here is a movie that was designed to be seen on the big screen with a lot of other people. It's a communal experience and something that needs overwhelming size to make it the kind of experience it was designed to be, and it was. It was designed to be on a wide screen with full surround sound, with a lot of other people sharing the moments." There's something about the shared experience of everybody laughing at the same moment, everybody gasping at the same moment, everybody yelling and cheering at the same moment that takes it to a whole different level than just sitting and watching it on a TV screen.

We will see what happens, because nobody has tried to reissue a movie on the scale we're doing since video has been invented. When we started, there was a lot of skepticism about whether all the money poured into refixing the movies would ever be recouped and all that sort of thing, but my feeling is it's like going to a baseball game or a rock concert. You can see it better on television or hear it better on the album; but there's something about the experience of being there that lifts it way above just listening to the CD or watching it on TV.

So will you shoot your future films for the large screen, or the small TV screens that are more ubiquitous?

I love television because you can tell different kinds of stories that you could never tell on the big screen. The big screen is very demanding in a very particular kind of way; on the small screen you can actually tell a more intimate story with more intellectual content.

I can foresee a third screen happening, a home screen somewhere between TV and a movie screen in size.

What's happening is the movie screen is becoming that "third" screen, and the big screen is becoming the IMAX or the next 3-D, super-engrossing experience. They're building more and more of these. Before, there were like 20, and now there's more than 200 IMAX, OmniMax, 3-D experience theaters. And their films are getting a little bit longer and a little more dramatic. Most multiplexes are probably going to end up with one of those, and you're going to see more people making movies for those screens, so that's going to be this kind of super-encompassing experience. Then at home you'll have a TV screen, which will be, you know, 5 feet by 2 feet.

> **"That people should own their own image, which is true in most primitive cultures, is something we've given away."**

And someday it will be high-definition TV. Will HDTV change the nature of what is shown on television?

I don't think it will change content much at all. HDTV is just a sharper image – but not that much sharper. Going to a movie theater to see an image that is 20 feet high and 40 feet long while sitting with a thousand people in a room is a very different experience from watching TV – even HDTV – alone at home. Content is much more influenced by market forces than by technology. Stuff made for television is different because the market is different. It's free for one thing; people are less discriminating about what they watch. So the creator can be more adventurous. You can tell more interesting stories on TV than on film because there are more outlets, cable and such. Feature films are so expensive that what you make has to fall into three or four market niches or it is simply not going to happen. Digital technology allows us to cross media. Normally TV is limited by resources to talking heads. But I was able to do grand scale on TV for the same budget because I was using digital technology. And digital technology allows me to make stories for film on a bigger, epic scale, with a grander sweep, than was even conceivable before.

Another question about scale: "Two guys in a garage" is the basic building block of Silicon Valley. Can you imagine a time when a culturally significant movie can be made by just two guys in a garage?

Definitely. Definitely. That's what we did in film school. So far nothing culturally significant has been made in a film school, but it's all relative, of course. On my first film, *THX-1138*, there was a very, very small crew. I mean, it wasn't two people, but it was less than 20, so it was a very small group. It was made with very, very little money. Now we have things like Hi-8 and Photoshop. Some of the special effects that we redid for *Star Wars* were done on a Macintosh, on a laptop, in a couple of hours. And they look exactly the same because they're intercut with the old shots. Obviously, they were done by somebody who's brilliant. But at the same time, the mechanical technical wherewithal to do it exists today. I could have very easily shot the *Young Indy* TV series on Hi-8. *Young Indy* looks like big, giant movies. I mean, the quality is just as good; no one would have known the difference. So you can get a Hi-8 camera for a few thousand bucks, more for the software and the computer; for less than $10,000 you have a movie studio. There's nothing to stop you from doing

212 ►

Lucas

◄ 211

something provocative and significant in that medium.

So why aren't there more guys in garages doing great movies?

It's hard. Why aren't there more people writing great American novels? I mean, that's what it comes down to. All the stuff is there. Everybody in this country who has graduated from high school, in theory, should be able to write the great American novel. Why don't they? Or at least a bad, sleazy novel that can sell for hundreds of millions of dollars to the film industry.

That they're doing!

Yes, but not even many people do that. The thing that stops it now is the marketplace, the distribution thing. Of course, it takes talent and courage and most people don't want to attempt it, but you're going to find more and more people - especially as the Internet-cable configuration begins to become more accessible - start doing it. Once distribution frees itself up and more people have access to the distribution channels, you're going to find more people doing that; if you can sell a "view-on-demand" movie for 50 cents and it cost you $50,000 to make, you could find enough people - 100,000 - who will watch it. The big problem is doing marketing and trying to figure out what your thing is; but if you can develop a channel that has a certain cachet to it and if you can continually pump that kind of material out, you've suddenly got yourself a channel.

"Content is more influenced by market forces than by technology. Yet digital technology allows a bigger scale than ever before."

We've heard this promise before in the technology of the '90s - interactive, CD-ROM stuff. What happened to that?

That was a nonidea to begin with.

Yes, but you guys at Lucas were pretty involved with it on some level.

We have a games group. Interactivity is games - how hard is that to figure out? Everybody said, "Well, you're going to have to have interactive movies." You don't have to have interactive movies. There's games, and there's movies. Movies are storytelling; you tell somebody a story. A game is interactive; you participate in some kind of an event with a lot of other people or with yourself, or with a machine. Those are two different things, and they've been around forever. Games have been here since the Greeks, and so has storytelling.

You don't think those two are going to cross over at all?

No! Because by definition they're different - storytelling and games are two different mediums. The fact that games are going to look more like movies, and you'll be able to interact with cybercharacters that look very real, and you'll be able to have conversations with them, that doesn't suddenly make it a movie or storytelling. You're using the same techniques that you're using to make movies in a game environment, but it's still a game. I don't care how you do it, once you have no story to tell, it's different. If I'm interacting, then that's a whole different kind of experience. We're talking, and I don't know what you're going to say; you don't know what I'm going to say. If I punch you in the nose, I don't know what the reaction is going to be because it will be different every time it happens. That's a game. If I'm telling a story, and the interest in it is the fact that I'm telling you something, and you are listening because I can tell it to you in an interesting way, that's why you're there. Psychologically, it's a different kind of experience.

We agree they are different, but perhaps there's some imaginable hybrid. I don't know how big a possibility space it would be, but I could see semidirected stories. Like improv dinner theater where you become part of a mystery while you eat. It feels like something in between a story and a game.

Yes, but it's so marginal. You're doing one for one reason and another for another reason. I mean, that's the difference between playing catch with your son and reading a book. You're doing them for two different reasons. The idea of combining reading the book and playing the game isn't that interesting. It's like trying to swim and fly at the same time - um, I guess they call that diving.

Is there any technology you're working on today that has the potential to revolutionize film a few years from now?

We are still pushing the envelope to get a really good and well-run all-digital post system.

What's holding it up?

We developed a system called EditDroid, but we didn't want to be in the hardware business, so we sold it to Avid. They are focused on the mass market. It's a matter of getting their enthusiasm for something that is considered to be a high-end item, even though obviously it would trickle down into the mass marketplace. In EditDroid we were able to store over a million feet of film. It advances every year, but we always need more storage.

This [holding up pencil] is an imaginary magic wand. You wave it and it does whatever you want. It could be a black box - only it has to be something that would help you and not help others. What would you have it do?

That's hard, because most of the things I do are to help others.

Well, it could be that editing system you always wanted.

If I could have that magic wand, I guess what I'd love to have is infinite storage.

You think a lot about education - indeed, you have been producing educational materials. You even wrote an essay on education for this magazine ("Access to Education," ***Wired*** **2.09, page 92). Do you think that the online networks and educational software that currently complement schooling will ultimately replace it?**

You need an educational system. I can't fathom how it would work without one. One of the more important parts of education is socialization - learning to cooperate and work with other people, particularly in the workplace. Interpersonal relationships are very cru-

216 ►

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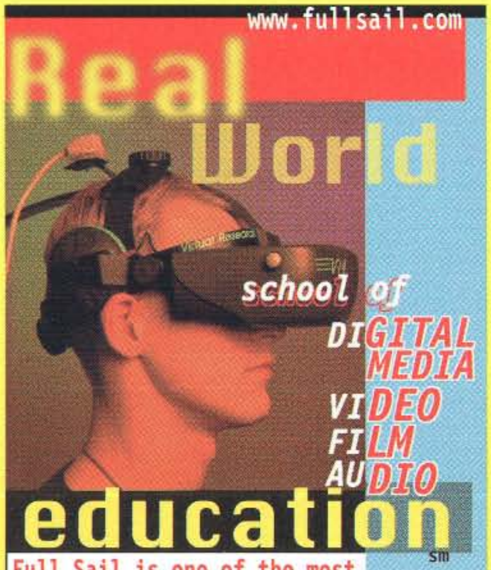

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◀ 212 cial to the educational system, and they need to be done in a communal environment, which means you will always need an educational system.

Like a lot of kids who read science fiction, I thought I knew what the future looked like – it was stainless steel and clear plastic. Yet, one of the most surprising things about your vision of the future in *Star Wars* was that it was filled – for the first time – with grime and dirt and wear and tear and cheery dilapidation. It took the sterility out of the future. This high tech lowlife changed how a lot of people thought about the future. That was a very profound insight; where did it come from, and when did it come to you?

I wanted to tell a story. I wanted to make sure that what I was doing was not construed as science fiction: This was space fantasy. This was like opera. This was a genre of fairy tales or mythology. But although it was completely made up, at the same time it had what Kurosawa would say is "immaculate reality." If you are going to strive for immaculate reality, obviously everything is kind of dirty in the real world, and everything is kind of beat up, and everybody doesn't drive around in a brand-new car. *Star Wars* is a completely made-up universe; it doesn't hold to any scientific rules, really. But at the same time, it is very logical in a certain kind of clock way. Once you've set up a particular kind of rule, you don't break that rule, so I was very careful to make it as realistic as possible even though it is a completely fantasy world.

I've heard you buried a time capsule here at Skywalker Ranch. An interesting fact about time capsules is that a significant portion of them are lost, even within 10 years of being buried. Are you are sure you know where it is?

Yes, it is in the corner of the building.

Do you know what's in it?

I don't know everything that's in it. There are a lot of artifacts from *Star Wars*, and from the company. It's just trivia stuff, basically.

When is it due to be resurrected?

Never.

Never?

Well, I mean it's for some archeologist 2,000 years from now to discover. There is no point in raising it. We have an archive, over there [points out the window to another building], and it is very big. But after a few hundred years it will be gone, so the only thing left is the time capsule.

Why did you make it?

I don't know, just for the fun of it. When we are all gone and the microbes have taken over, and they begin to speak and think and do things that we have done, they will dig it up some day, and say, "Look, humans were here."

You have a pretty extensive library here, which is a bridge to the past, and you have a time capsule, which focuses our attention on the far future. That extremely wide span of attention is very unusual for a modern American. Where did that come from?

I'm a history buff. I started out in anthropology. I am very interested in culture. Most of what I do centers on that.

If we gave you one round-trip ticket to go to the past or to the future, which way would you go?

Well – that's an interesting question. That would be a struggle for me. Can I get two? Boy, I don't know. I'd probably go to the future.

How far?

At least 1,000 years.

Why 1,000?

Because my feeling would be that if I went too much further it would be incomprehensible. A thousand years isn't going to be that different. I would at least have some kind of sense of what it was I was looking at. If I was born 1,000 years ago and I came here, it would be pretty amazing, but it wouldn't be so much so that I couldn't sort of adapt. If you brought someone from 5,000 years ago, they probably could not adapt. It would be so overwhelming that they would be at a loss.

Well, one thing they will probably have 1,000 years from now is virtual personalities that are viable, bankable commodities. If somehow you had a 3-D digital Luke Skywalker, you could be putting him into movies for the next 100 years.

That's what I'm doing anyway. I can put Yoda in a hundred movies.

You can rent him out?

I can put him in the next Jim Carrey movie if I want to. I could work him just like an actor. Conceivably you can get to a point where you can create a character that anybody can use, and you can put him in any kind of an environment. Kermit and some of those characters are the same way. Bugs Bunny, though not quite digital, could be a digital character. He looks as much like a digital character as Woody or Buzz Lightyear does, and they would argue about who is the better looking of the group.

So how do you imbue them with spirit, and soul?

It's no different than what Tolstoy did. You are going to be able to take Anna Karenina, turn her into a three-dimensional person, and put her into a particular environment instead of just a bunch of words on a page. The fact that eventually you'll have artificial intelligence that will be able to take on a particular persona is a whole other issue; it won't happen in our lifetime, so I'm not too worried about it. But we will be able to create the 3-D character. That's going to happen in a few years. The 3-D character is animated by a human being to make it react in a particular way, and that's Tolstoy. The real question is when that character starts to think for itself …

Who owns it? And who owns what it says?

It's not a matter of who owns it, but what are you going to do with it? How are you going to relate to it? What happens if you fall in love with it? The question will be when do they start asking for their own rights? They'll say, "I have as much right to be here as you do, and the problem with these humans is that are they are too dirty." And they will. 217 ▶

"There's games, and there's movies. Movies are storytelling. A game is interactive. By definition they're different."

Colophon

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Lucas

◄ 216

Speaking of digital characters, why did you sell off Pixar?

I had Pixar for 10 years. At that time it was primarily a hardware company that developed a lot of technology: digital printers, the first nonlinear editing system we developed, high-speed graphics. I wasn't particularly interested in being in that business. I'm a movie company. But I had companies that needed those technologies, Industrial Light & Magic and Lucasfilm. A couple of guys at Pixar, Ed Catmull and John Lasseter, wanted to do computer-animated movies. There was a lot of investment that had to be made there, and I wasn't really interested in spending $50 million developing animated films. I would much rather take that $50 million and develop a game company, or a lot of other things, than push the special-effects company. It was basically a hardware company with a couple of guys whose hearts were into the animated films. So they went off, and Steve [Jobs] bought it, and after a few years Steve sold the hardware company to somebody else, and he took John and Ed and a few of those guys and said, "OK, I want to make movies, too, so let's all get together and make movies," and that's really where it started. ILM is exactly like Pixar, except we don't do animated movies. We do animated pieces in feature films. I didn't need two companies that were doing the same thing.

> **"The curve of science shoots up like a rocket. But we're just as emotionally illiterate as we were 5,000 years ago."**

You've listed Japanese samurai films, *Flash Gordon* serials, and Joseph Campbell as the influences that inspired you while writing the first *Star Wars* trilogy. As you begin this prequel series, are you finding any new sources of inspiration?

The influences I use are just the way I live my life. A lot of this stuff I've been gathering since I was in college; the basics were done 20 years ago. In the case of *Star Wars* I had studied mythology in my cultural anthropology class for a year, so I knew something about it, but then I went back and started doing a lot more research in that area, and in history. I just keep going through it. I'm obviously reinterpreting it for today, but the core of it is actually pretty old.

At one time you said, "Technology won't save us." Do you think technology is making the world better or worse?

If you watch the curve of science and everything we know, it shoots up like a rocket. We're on this rocket and we're going perfectly vertical into the stars. But the emotional intelligence of humankind is equally if not more important than our intellectual intelligence. We're just as emotionally illiterate as we were 5,000 years ago; so emotionally our line is completely horizontal. The problem is the horizontal and the vertical are getting farther and farther apart. And as these things grow apart, there's going to be some kind of consequence of that.

So would you say your films are a bridge between those two curves of emotion and intelligence?

Storytelling, art, mythology has always been an attempt to bridge that gap. I'm not doing much better than Sophocles did (if I could only aspire to that level). Even after Freud, we're still bouncing around with so little sense of what controls that intellectual part. But I'm very optimistic. We managed to get past a nuclear era that was the perfect example of a stupid caveman with a club, a club that can destroy the planet. You can't keep the intellectual side going without expanding emotional intelligence, too. Intellectual intelligence is not fair. It just gives you a bigger club. It doesn't at all tell you how to use it. We're still just figuring out how to make a bigger club.

A futurist in our magazine said Yoda was his hero. Who are your heroes?

I won't answer that. It's too revealing. Yoda is just one of my kids. ■ ■ ■

Message 44:
Date: 2.1.97
From: <nicholas@media.mit.edu>
To: <lr@wired.com>
Subject:

Pay Whom Per What When, Part I

When you fly your dog across the Atlantic, you pay a fixed fee. By contrast, inter-European airfare is determined by your dog's weight. Now, imagine that you couldn't buy an individual airline ticket for yourself or your dog. Instead, suppose airlines offered an annual pass that covered an unlimited number of flights. Or, imagine that you could buy individual tickets and the price was determined by your weight.

Americans can't seem to comprehend the British National Health Service, yet they pine for the simplicity of Steve Forbes's flat tax. We hold strong if seldom consistent views on how we should pay for things.

The digital world has created an opportunity to totally rethink billing methods. In turn, we will be forced to revisit the fundamental concepts supporting service cost and customer value. Most debates today on whether and how the Internet should be tariffed are mere reruns of debates that already have been played out in the world of atoms. Tomorrow's debates will be different. They will focus on issues unique to the world of bits. Unlike atoms, bits aren't consumed by consumers. They can regenerate – infinitely.

There is an unspoken acknowledgment that the rules of trade have changed. Bits aren't sold the same way atoms are sold.

Subscribing to subscription

During the next few years, we will witness an explosion of payment methods. Yet, unlike the 40-odd calling plans offered by your cellular telephone provider today, payment plans will combine two principal ideas: flat fee and pay-for-use. Neither of these is superior to the other, but we'll see innovation in both.

The mind-set of most netizens, both consumers and service providers, supports a flat fee – a fact the European telcos still don't understand. But the digerati are at fault as well for not recognizing the rush toward pay-for-use. Both can, and will, benefit the consumer.

From the consumer's point of view, there are two apparently contradictory arguments in support of flat fees: certainty and serendipity. People like to know in advance what something will cost, even if the flat fee results in a cost that may be higher than they would have paid "by the meter." Also, people want to browse, window shop, or find some unexpected treasure without the sound of a meter ticking.

From the seller's point of view, flat rates offer even greater advantages. First, cost savings. Fifty percent of the price of a phone call covers billing – the cost of a call is cut in half right away by changing billing rates to a flat fee. Second, the relative certainty of income. The cost of a magazine subscription – typically much less than the price of a year's worth of newsstand issues – serves as an excellent example. The information provider is guaranteed a certain amount in sales and, further, gets paid in advance – both of which help cash flow. The more the provider has to invest in advance of sales, the better this appears.

Marginal marginal costs

The flat-fee concept is particularly desirable when marginal costs to the supplier remain, well, marginal. Europeans are astonished by the American practice of refilling the customer's coffee cup for free – try that on the Piazza San Marco or Champs-Élysées. Yet the marginal cost of an extra cup of coffee is low, making the practice well worth the price, given the possibility of attracting new customers – even those who don't drink the extra coffee. In the world of bits, marginal costs are often indistinguishable from no cost. Once a user consumes a few bits, why not let him or her have a few more for free?

What if the marginal cost to a supplier, who offers increased use, was actually negative? The increasing incidence of advertising on the Net makes this a growing possibility, so much so that I predict within three years few people will pay their local ISP for Internet access, and potential high-value customers will be paid to surf.

Digital dumping

Japan consistently has been accused of dumping, whether it's supercomputers or semiconductors. The complaint results from the allegedly predatory practice of taking huge losses until the competition is obliterated, at which point a completely monopolistic position can be taken resulting in exorbitant fees. American trade associations cry foul. Congress is never far behind.

Yet Netscape emerged and gave its browser away for free. Now, with 70 percent of the world's market share, the company charges US$49 and up per copy. Not a peep from anyone. Is this because Americans whine about dumping only until we do it successfully? No. It's because there is an unspoken acknowledgment that the rules of trade have changed. Bits aren't sold the same way atoms are sold.

Netscape introduced an entire new class of payment. Instead of a one-off payment for a given capability (x) or a usage-independent subscription (x/t), Netscape pioneered the idea that what you pay for is effectively the rate of change in functionality ($\partial x/\partial t$, for the left-brained).

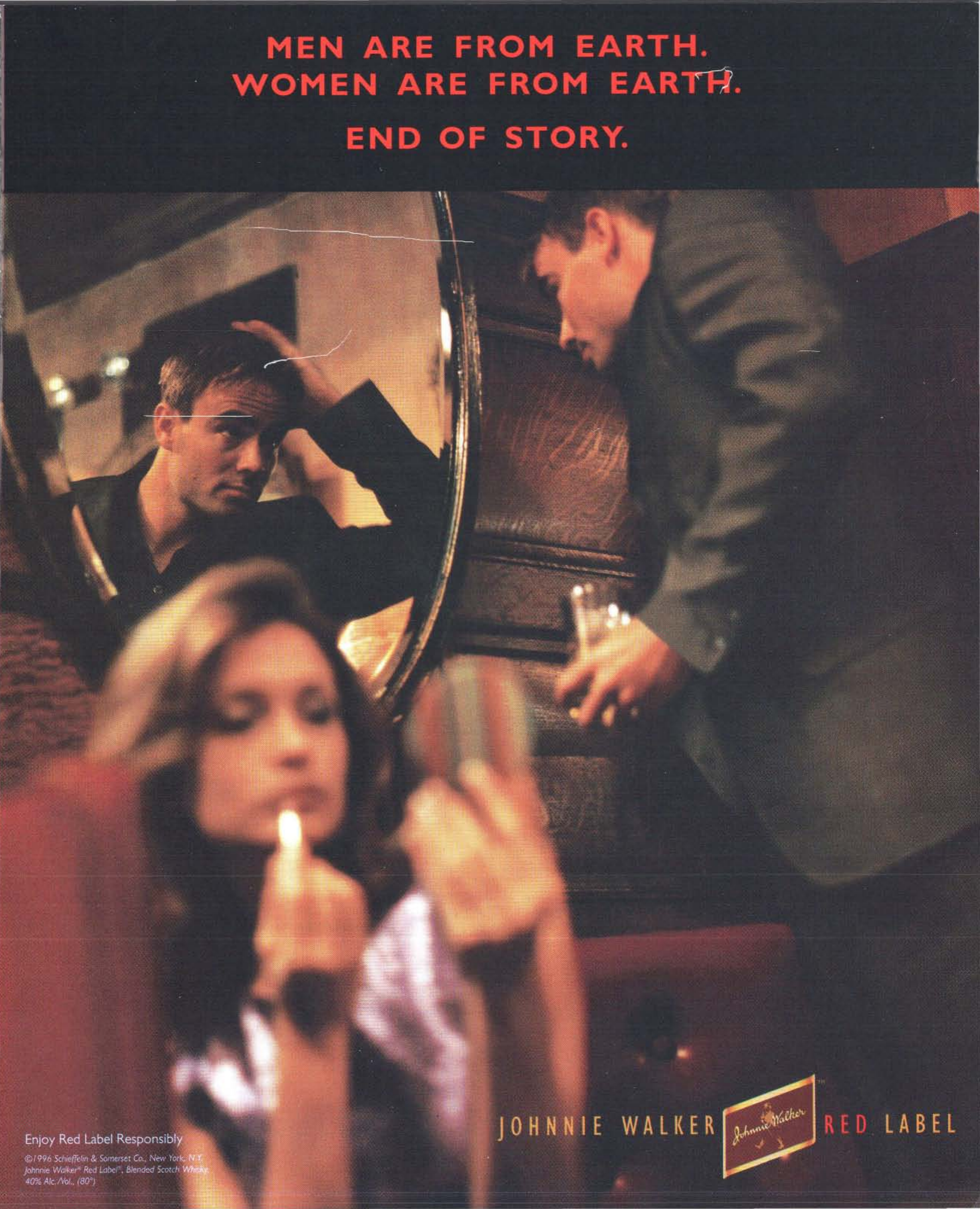
All forms of usage-independent pricing, however, have their downside. If you use something rarely, why pay a monthly overhead? As someone who drives little, I find the Swiss and Greek systems of annual road fees far less attractive than the French and Italian toll systems where you pay as you go.

Alas, the cost-savings argument of a fixed fee is rapidly disappearing for suppliers. This is due to the falling price of computer cycles and the introduction of new forms of electronic payment, both of which help reduce the cost of transactions to virtually zero. Today it costs a dollar to process a check and 25 cents to handle a credit card transaction. When payment systems cost a penny, the case for fixed-fee quickly erodes.

However, the real driver for pay-for-use is more subtle: it is the opportunity to tie payments more closely to customer value, as discussed in the next issue. ■ ■ ■

This article results from conversations at CSC Index Vanguard meetings with Richard Pawson (rpawson@csc.com). *Pawson, who coauthored much of the text, is director of research for the CSC Index Foundation.*

Next Issue: Pay Whom Per What When, Part II



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